CLUSTER DEVELOPMENT BASED AGRICULTURE TRANSFORMATION PLAN VISION-2025

Apple Cluster Feasibility and Transformation Study

Planning Commission of Pakistan, Ministry of Planning Development and Special Initiative

February 2020

FOREWORD

In many developed and developing countries, the cluster-based development approach has become the basis for the transformation of various sectors of the economy including the agriculture sector. This approach not only improves efficiency of development efforts by enhancing stakeholders' synergistic collaboration to resolve issues in the value chain in their local contexts, but also helps to gather resources from large number of small investors into the desirable size needed for the cluster development. I congratulate the Center for Agriculture Bioscience International (CABI) and its team to undertake this study on **Feasibility Analysis for Cluster Development Based Agriculture Transformation.** An important aspect of the study is the estimation of resources and infrastructure required to implement various interventions along the value chain for the development of clusters of large number of agriculture commodities. The methodology used in the study can also be a guide in evaluating various investment options put forward to the Planning Commission of Pakistan for various sectors, especially where regional variation is important in the project design.

Muhammad Jehanzeb Khan,
Deputy Chairman
Planning Commission of Pakistan
Ministry of Planning Development and
Special Initiatives
Government of Pakistan.

FOREWORD

To improve enhance Pakistan's competitiveness in the agriculture sector in national and international markets, the need to evaluate the value chain of agricultural commodities in the regional contexts in which these are produced, marketed, processed and traded was long felt. The Planning Commission of Pakistan was pleased to sponsor this study on the **Feasibility Analysis for Cluster Development Based Agriculture Transformation** to fill this gap**.** The study aims to cover a large number of agriculture commodities spread in various clusters throughout the country.

I truly hope that the policies, strategies, and interventions suggested in this report will facilitate the federal and provincial governments to chalk out and implement plans for cluster-based transformation of the agriculture sector.

Zafar Hasan,
Secretary,
Ministry of Planning Development and Special Initiatives
Government of Pakistan

FOREWORD

This is part of the series of studies on 33 agriculture commodities undertaken for preparing a cluster-based transformation plan based on the regional realities in the entire value chain including production, processing, value addition, and marketing. I congratulate the whole team of the project especially the Team Lead, Dr. Mubarik Ali to undertake and successfully complete this monumental study. We are thankful to all commodity specialists who have contributed to this assignment. The CABI Project officers Mr. Yasar Saleem Khan and Ms. Aqsa Yasin deserve appreciation. I truly believe that this study will serve as a basis to make and implement plans for cluster-based agriculture transformation. I hope you will enjoy reading the study and it can help you making your investment decisions along the value chain of various agriculture commodities.

Dr. Babar Ehsan Bajwa
Regional Director
CAB International

FOREWORD

This report is part of the series of studies on 33 agriculture commodities to prepare the agriculture transformation plan by incorporating regional realities at the cluster level. In the report, the clusters of various commodities are identified and characterized and viable investment options along the value chain of each cluster are proposed. For this purpose, the study team has analyzed macro data, reviewed the literature, and made extensive consultation with stakeholders along the value chain. Foreign and local internationally reputed consultants, Dr. Derek Byerlee and Dr. Kijiro Otsuka and national consultant Mr. Sohail Moghal were also engaged to understand the cluster-based development approach and conduct cluster-based feasibility analysis. An EXL-based Model was developed which was validated by our national consultants. Separate viabilities for individual technologies and products suggested in each commodity are also estimated. This humongous task would not have been possible to complete without the excellent cooperation and facilities provide by CABI, the hard work of commodity specialists and our research team especially Mr. Yasar Saleem Khan and Ms. Aqsa Yasin. The true reward of our hard work is the implementation of the proposed policies, strategies and interventions to develop agriculture commodity clusters in the country.

Dr. Mubarik Ali
Team Leader
Cluster Development Based Agriculture
Transformation Plan-Vision 2020 Project

ACKNOWLEDGEMENT

It is not possible to mention the names of all those who collaborated with us in completing this report, but my foremost gratitude goes to numerous stakeholders along the value chain who generously shared the information about apple production, marketing, trade and value chain. Without their support, this report would not have reached to the level of present quality.

My sincere thanks go to **Planning Commission of Pakistan** for this initiative and especially financial assistance to complete the project activities. Here I am especially thankful to **Dr. Muhammad Azeem Khan** (Ex-Member, Food Security and Climate Change, Planning Commission of Pakistan), **Dr. Aamir Arshad** (Chief Agriculture, Ministry of Planning, Development and Special Initiative), **Mr. Muhammad Akram Khan** (Project Director; CDBAT) and the team from Planning Commission of Pakistan **Mr. Muhammad Arif** (Research Associate) and **Dr. Habib Gul** (Research Associate) for successful coordinating the project activities and preparation of this report.

I am also grateful to **Centre for Agriculture and Bioscience International** (CABI), its Director for Central and Western Asia, Dr. Babar Ehsan Bajwa, and CDBAT project team for selecting me as commodity specialist for this task and offering outstanding cooperation, support and advice during all the stages of this project. However, the research team takes the responsibility of any shortcoming left in the report.

Dr. Muhammad Javed Tareen
Senior Author

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DISCLAIMER

This report is prepared by using the data from various published and unpublished sources and that obtained during the consultations with stakeholders. The research team took utmost care to arrive at the figures to be used, but is not responsible for any variation of the data in this report than those reported in other sources. Moreover, the views expressed in this report are purely of the authors and do not reflect the official views of the Planning Commission of Pakistan, Ministry of Planning Development and Reforms or the Centre for Agriculture Bioscience (International).

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LIST OF ACRONYMS

AJK	Azad Jammu and Kashmir
ARDC	Apple Research and Development Center (Proposes)
CABI	Center for Agriculture and Biosciences International
CC	Collection Centers
CPEC	China Pakistan Economic Corridor
FAO	Food and Agriculture Organization of the United Nations
FATA	Federally Administered Tribal Areas (Defunct)
FYM	Farm Yard Manure
GAP	Good Agriculture Practices
GB	Gilgit Baltistan
GI	Geographical Identification
GPU	Germplasm Unit
Ha	Hectare
HACCP	Hazard Analysis and Critical Control Point
IFS	International Food Standards
IPPC	International Plant Protection Convention
IRR	Internal Rate of Return
Kg	Kilo gram
KP	Khyber Pakhtunkhwa
MIS	Market Information System
MOU	Memorandum of Understanding
NGO	Non-Governmental Organization
NPV	Net Present Value
PFVA	Pakistan Fruit & Vegetable Exporters & Importers Association
SPS	Sanitary and Phyto-sanitary
SWOT	Strengths Weaknesses Opportunities and Threats
USA	United States of America

EXECUTIVE SUMMARY

The apple is the third most grown fruit in the world. In 2017, it is cultivated on about 5 Million ha producing over 83 Million tonnes of apple with an average per ha yield of 17 tonnes. About 9 Million tonnes of apple is annually traded in the world. China remained top producing country with a production of more than 46 million tonnes followed by USA. Pakistan's ranks at 23rd in terms of production among the apple producing countries by cultivating the fruit on 95.3 thousand ha and producing 670 thousand tonnes of apples with an average yield of 7.0 tonne.

The total value of apples traded in the world was US$6.2 billion in 2016. China also remains at top in apple exporting country followed by USA. Pakistan is a net-importer of apple. In 2016-17, although Pakistan exported a small quantity of apple, it remained a net importer of 79.4 thousand tonnes of apple costing US$27.3 million.

Despite the good rate of growth in per ha yield and production of apple in Pakistan, particularly in Balochistan, the country remains uncompetitive in apple value chain in national and international markets as reflected by the lower per ha yield, increasing imports, and lower export-production ratio and export prices compared to the world average. For example, the yield per ha in Pakistan is 42% of the world average, and its apple export fetches 76% of the world average export price.

In this situation of deteriorating competitiveness of apple value chain in national and international market, the Planning Commission of Pakistan has initiated this study to find out constraints and opportunities and suggest economically viable interventions at various segments of the apple value chain. Such analysis was considered more relevant if conducted at apple growing clusters in the country.

The Balochistan and KP provinces are the main apple producing areas of Pakistan, although Azad Kashmir and GB also contribute considerable volumes of apples in national production. On the basis of available production data, two main apple growing clusters are identified, i.e. Central Cluster, and Northern Cluster of Balochistan. As production in KP and GB has been on a declining trend because of the improving profitability of other crops in the region, no viable apple cluster is identified for this region. Lack of reliable data on AJK also preclude us to include any apple cluster from the region in this analysis.

The existing apple industry of Pakistan is facing multi-dimensional challenges from production to harvesting and marketing. On production side, water scarcity and low yield are the main challenges while, on marketing side, value chain, cold chain and processing segments are missing. Moreover, high harvest and post-harvest losses further deteriorate the competitiveness of the apple value chain in the country. However, the industry has immense potential to overcome these constraints and expand because of the new available technologies at the production and processing levels, fast increasing demands at international level, more importantly at the national level, possibility of new CPEC routes, and proximity of the apple cluster to the Middle East market.

This study suggests interventions to improve the competitiveness of apple value chain in the country. These interventions include renovation of old orchards with new high-yielding germplasm and higher plant density per ha supported with drip irrigation; maintaining high increase in yield in Killa Saifullah cluster; improving yield growth in central cluster by strengthening provincial and national research and extension system, and improving its link with national and international R&D system; introducing appropriate harvesting and post-harvesting technique by training the stakeholders along the value chain and encouraging appropriate infrastructure in the private sector to reduce post-harvest losses; incentivizing apple processing as a cottage industry; providing infrastructure like collection centers at the village level supported by appropriate grading, packing and cold storage systems with initial public support to manage these centers; and organizing the farmers into Farmers Entrepreneur Groups (FEGs) to improve the value chain and quality of apple in the domestic and international markets. It is proposed that these interventions should be executed through the private sector with the active financial and administrative support of the public sector.

Total estimated investment required for these intervention to be introduced at the focal points of both clusters in the project mode to be implemented in five years is US$46.5 million. About US$12.5 million investment cost will be borne by the government in terms of strengthening apple research, capacity building of farmers and other stakeholders along the value chain, subsidies on the establishment of pack houses, promoting processing, orchard rejuvenation, and collection centers at the farm-level, and providing interest free loans and US$34.0 million by the private sector. This investment will improve the value chain, thus its operational costs, the total value of which in both the clusters will be US$62.16 million during the 8th year of the project when all the costs will be fully realized. These investments and operational costs will generate a total gross revenue of US$155.4 million, and net cash flow of US$93.2 million both undiscounted. The pooled Net Present Value after offsetting all the operating costs incurred and the investments made in both the clusters came to US$153.7 million. The overall Internal Rate of Returns (IRR) from both the clusters is to tune of 47.6%: 71.0% for Central Balochistan cluster and 46.0% for Northern Balochistan cluster. This clearly implies that it is worth investing into both apple clusters of Balochistan province, which will be beneficial for the farmers, value chains stakeholders as well save precious foreign exchange spent on apple imports.

To make this initiative successful, the key elements would be strengthening the R&D facilities by establishing Apple R&D Institute at Quetta; mobilizing provincial Department of Agricultural Extension, and organize Framers' Entrepreneur Group (FEGs) at the Union Council level in apple growing areas. Signing of MOU with countries like USA, Italy, Chile for research collaboration; and developing apple marketing infrastructure on international standards can also be critical.

The cluster level infrastructure and investment requirements, induced cost and return for various stakeholders along the value chain, IRR and NPV of these interventions at the cluster level can be seen in the attached Summary Sheet.

Summary Sheet of Apple Clusters

Information	C. Cluster	N. Cluster	Overall
Area of cluster focal point (ha)	1,471	24,950	26,421
Production (tonnes)	13,312	261,975	275,287
Yield of the cluster (tonnes/ha)	9.05	10.50	10.42
Area of the cluster (ha)	16,859	34,790	51,649
Production of the cluster (tonnes)	155,007	332,144	487,151
Annual yield growth without intervention (%)	4.90%	1.83%	
Total apple orchards areas renovated in 5 years (ha)	221	3,743	3,963
Increase in production due to orchards renovated (tonnes)	2,921	45,417	48,338
Additional production value - orchards renovated (M. US$)	1.545	24.025	25.570
Increase in yield - improved management practices (tonnes/ha)	3.97	1.82	2.90
Increase in production -improved management practices (tonnes)	5,843	45,417	51,260
Additional production value-improved practices (M. US$)	3.090	24.025	27.116
Increased in production - reduced post-harvest losses (tonnes)	3,442	52,045	55,486
Additional production value from reduced losses (M. US$)	1.820	27.531	29.352
Production to be processed drying/processing (tonnes)	2,639	19,950	22589
Total volume of apple juice produced (tonnes)	1,885	14,250	16,135
Additional income from juice processing (M. US$)	2.262	17.100	19.362
Expected apple import without intervention during 8th year (tonnes)	-	-	536,279
Import substitution in 8th year (% of total production)			28.9%
Import substitution on 8th year (tonnes)	12,206	142,878	155,084
Value of import substitution on the 5th year (M. US$)	106.799	98.453	205.251
Total number of Juice Chillers required	5	33	**38**
Total number of certified nurseries required	1	16	**17**
Total collection centers required	1	25	26
Total pack-houses required	8	94	102
Investments (M. US$)			
Improving research infrastructure and operation	0.500	0.500	1.000
Capacity Building and FEGs for improved practices	0.054	0.924	0.979
Investments required on orchard renovation	1.221	20.711	21.932
Investment required on certified nursery establishment	0.028	0.468	0.496
Investments on establishing CC and FEGs	0.074	1.852	1.926
Investments required on pack house	1.281	15.057	16.338
Investments on processing/juice making interventions	0.241	1.590	1.831
Government loans on private investment	0.167	1.831	1.999
Total investment required over five year	3.567	42.934	46.501
Total public sector investments	1.291	11.191	12.482
Total private sector investment	2.276	31.743	34.019
Overall benefits and rate of return (M. US$)			
Increased production from yield enhancing interventions (tonnes)	12,206	142,878	155,084
Additional production value due to all interventions	6.457	75.582	82.039
Gross revenue due to all intervention in 8th year	12.967	142.404	155.371
Operational cost due to all interventions during the 8th year	4.541	57.623	62.165
Net cash flow	8.425	84.781	93.206
NPV	16.96	136.77	153.74
Internal Rate of Return	71.02%	45.95%	47.63%

1. INTRODUCTION

1.1 Apple industry of Pakistan

Apple (*Malus sylvestris*) is deciduous popular fruit crop. This tree crop is widely grown in temperate and colder regions of the world. The apple fruit is one of the most popular and healthy fruits as it stands 3rd in terms of production worldwide (Statista, 2018). Apple is not only consumed as fresh, it is also used for making different products like juices, jam, jellies, marmalade, cider, etc. The fruit is rich in fiber, calcium, phosphorus, iron, sodium, potassium, and vitamin C.[1] Apples contain considerable amount of polyphenols and relevant phytochemicals some of them contribute retarding cancer (Clarissa, 2008). Besides these dietary facts apple fruit contains antioxidants, which is very important for human health. The red color pigments of apple skin are anthocyanin, which protects humans against myriad of diseases.

The total production of apples in Pakistan during 2016 was 620.0 thousand tonnes from 96.9 thousand ha (Table 1). The Pakistan's yield is 6.41 tonnes/ha. The main apples producing provinces in the country are Balochistan, Khyber Pakhtoonkhwa (KP), and in Gilgit-Balitistan (GB), it is grown at over 1,000 meters above the sea level. Balochistan is main apples producing province where 85.05% of production is concentrated, followed by KP, which is producing 14.39% apples of the country. The rest of the country's production is negligible (Table 1). The productions of GB and Azad Jammu and Kashmir (AJK) are not reflected in this statistics although it also contributes significantly in the national apple production. The total production and area of apples grown in GB is 23.3 thousand tonnes from 4.2 thousand ha (Government of Gilgit-Baltistan, 2014). In AJK, total apple production is 53.2 thousand tonnes from 383.8 thousand trees (Azad Government of the State of Jammu and Kashmir. 2009).

Table 1: Major apple producing provinces in Pakistan (2016).

Province	Production (tonnes)	Production Share (%)	Area (ha)	Area share (%)	Yield (tonnes//ha)
Balochistan[1]	527,642	85.05%	88,807	91.62%	5.9
KP[1]	89,333	14.39%	7,741	7.98%	11.5
Other[1]	3,506	0.56%	380	0.40%	9.2
Total	**620,481**	**100.00%**	**96,928**	**100.00%**	**6.4**
Gigit/Baltistan[2]	23,331	-	4,241	-	5.5
Azad Kashmir[3]	-	-	53,186	-	

Source: Government of Pakistan (2018b); [2]Source: GGB (2014); [3]Source: AGSJ&K (2009).

[1] A 100 gm of apple constitutes about 84.4% water, 0.02 gm fat, 14.1% carbohydrates, 7 mg calcium, 10.0 mg phosphorus, 0.3 mg iron, 1.0 mg sodium, 110.0 mg potassium (Westwood, 1978)

During 2006-16, the rate of increase in apple production in Pakistan has been high with an average annual growth of over 6.09%. More interestingly is that most of this growth came from yield increase rather than area expansion under apple cultivation. This implies that the production management practices and technologies are improving in apple cultivation. All of the increase in apple production came from Balochistan, while apple production in KP has declined. More surprising is the fact that area of apple cultivation in Balochistan is regularly declining since 2006-07 (perhaps marginal lands for apple cultivation has gone out of cultivation due to water shortage), while the rate of yield increase in the province is phenomenal at about 10.86% per annum during the period (Table 2).

Table 2: Trend in area, production and yield of apples in Pakistan by province during 2006-17.

Year	Balochistan			Khyber Pakhtunkhwa			Pakistan		
	Area	Prod.	Yield	Area	Prod.	Yield	Area	Prod.	Yield
	(ha)	(tonnes)	(kg/h)	(ha)	(tonnes)	(kg/h)	(ha)	(tonnes)	(Kg/ha)
2006-07	102,802	219,535	2,136	9,404	125,220	13,316	112,600	348,440	3,,094
2007-08	103,279	313,605	3,036	9,372	124,470	13,281	113,000	441,575	3,908
2008-09	102,900	306,530	2,979	9,683	130,820	13,510	113,100	441,062	3,900
2009-10	102,100	250,900	2,457	9,101	112,100	12,317	111,597	366,360	3,283
2010-11	102,227	426,754	4,175	8,000	95,600	11,950	110,562	525,855	4,756
2011-12	102,043	497,644	4,877	7,983	97,619	12,228	110,411	598,804	5,423
2012-13	95,482	461,279	4,831	7,963	91,483	11,489	103,943	556,307	5,3578
2013-14	96,692	510,203	5,277	8,076	92,268	11,425	104,998	606,016	5,763
2014-15	91,945	522,729	5,685	7,921	90,513	11,427	100,246	616,748	6,152
2015-16	88,807	527,642	5,941	7,741	89,333	11,540	96,928	620,481	6,401
2016-17	87,171	576,376	6,612	7,707	89,984	11,676	95,260	669,912	7,032
Annual growth (%)	**-1.77**	**9.10**	**10.86**	**-2.37**	**-4.11**	**-1.74**	**-1.81**	**6.09**	**7.90**

Source: Government of Pakistan (2018b).

Pakistan is a net importer of apple, because its exports are much lower compared to the imports. The imports of apple have sky-rocketed from just 3 thousand tonnes worth of US$0.5 million in 2001 to over 78 million tonnes worth of US$ 34.4 million in 2016, while exports of apple fluctuated during the period. As a result, the apple trade deficit has ballooned from just US$200 thousand to US$34 million in the corresponding period (Table 3). This clearly calls the agricultural policy makers for giving urgent attention to enhance apple production in the country.

Table 3. Pakistan's import, export, and trade deficit in apple trade during 2001-16.

Year	Import		Export		Trade deficit	
	Quantity (tonnes)	Value (000 US$)	Quantity (tonnes)	Value (000 US$)	Quantity (tonnes)	Value (000 US$)
2001	3040	513	888	305	2152	208
2002	2440	418	818	307	1622	111
2003	3831	688	250	79	3581	609
2004	4479	736	97	60	4382	676
2005	814	199	100	61	714	138
2006	7563	1334	146	59	7417	1275
2007	6563	1272	428	177	6135	1095
2008	13497	2075	20	8	13477	2067
2009	9206	1683	2278	818	6928	865
2010	11939	2228	1573	480	10366	1748
2011	16282	3779	996	451	15286	3328
2012	23917	5744	2165	864	21752	4880
2013	35359	9977	599	287	34760	9690
2014	26276	7170	807	405	25469	6765
2015	51447	16819	376	163	51071	16656
2016	78164	34361	767	361	77397	34000

Source: FAOSTAT Trade, Crop and Livestock Products Data http://www.fao.org/faostat/en/#data/TP

1.2 Apples Production in Global Perspective

The world apples production was recorded as 83.1 Million tonnes from 4.9 Million ha with an estimated yield of 16.86 tonnes/ha (FAOSTAT, 2016). Internationally, the apple production is expanding at an annual rate of 2.4%. It is worth noting that this increase in production is higher than the increase in world population implying that per capita consumption of apple is increasing globally. Most of this increase is coming from yield improvement rather than expansion in area under apple cultivation. The average annual increase in area is 0.8%, while yield increases at the annual rate of 1.6% during the ten years period (Table 4).

In international market, fresh apple is preferred for imports than apple juices as the value of the apple juice exported is around US$1.0 billion and has remained stagnant overtime, while the export of fresh apple has increased from US$6.3 billion in 2008 to US$7.3 billion in 2016. The annual growth rates in international trade in fresh apple quantity and values are at 1.72% and 3.07%, respectively during the period.

The growth in export quantity is less than the growth in international production, implying some enhanced quantities of production are left with in the producing countries. Similar is the case in Pakistan. Apple production in the country is increasing at a sufficient higher rate (i.e., 6.4%)

than population growth of 2.1% per annum and export is also insignificant during the last decade. Therefore, most of the additional production of apple is absorbed within the country. This resulted in higher per capita annual consumption of apple within the country from 1.68 kg in 2010-11 to 2.40 kg in 2013-14, which is over 40% increase within three years (Federal Bureau of Statistics, 2010 and 2013).

Table 4. Trend in the world apple production and export during 2008-17.

Year	Production (Million t)	Area (Million ha)	Yield (tonnes/ha)	Export quantity (Million t)	Export value (Billion US$)
2008	69.04	4.67	14.784	7.81	6.38
2009	71.64	4.75	15.082	7.92	5.61
2010	71.19	4.89	14.558	8.59	6.48
2011	77.08	4.99	15.447	8.26	7.15
2012	78.61	5.07	15.505	8.28	7.18
2013	82.84	5.16	16.054	8.58	8.03
2014	85.48	5.14	16.630	8.43	7.47
2015	82.45	5.10	16.167	9.30	6.97
2016	85.20	5.16	16.512	9.04	7.27
2017	83.14	4.93	16.864	-	-
Annual Growth (%)	**2.4**	**0.8**	**1.6**	**1.72**	**3.07**

Source: FAOSTAT, Production, Crop Data [http://www.fao.org/faostat/en/#data/QC]
FAOSTAT Trade Data [http://www.fao.org/faostat/en/#data/TP]

Top apples producing countries include China, USA, Poland, and Turkey (Table 5). Pakistan do not appear in the table because of its low productivity. Although, Pakistan is ranked at position 9 for area under apple cultivation but its ranks are at 23rd in production due to lower yield. The chilling requirement of apple ranges from 250 to 2,000 hours for quality apples production. However, suitable area and appropriate variety are also required conditions for quality apples production on commercial basis.

Table 5 : Top apples producing countries of the world in 2016-17.

Rank	Country	Production (Million tonnes)	Area (000 ha)	Yield (kg/ha)
1.	China	44.447	2,383.8	18,645
2.	USA	4.649	130.5	35,613
3.	Poland	3.604	177.2	20,340
4.	Turkey	2.925	173.4	16,874
5.	India	2.872	314.0	9,147
6.	Iran	2.799	238.6	11,730
7.	Italy	2.455	56.1	43,722

8.	Russia	1.843	214.3	8,604
9.	France	1.820	49.6	36,675
	World	**83.139**	**4930.0**	**16,851**

Source: **FAOSTAT, Production, Crop Data [http://www.fao.org/faostat/en/#data/QC]**

Pakistan has lagged much behind the world in terms of yield, export-production ratio, and export price. Due to the disconnect of traders with international market and inappropriate export policies, Pakistan exports only 0.008% of its apple production, while on average world exports count more than 10.9% of the apple production. Low apple prices at the farm gate may indicate the low quality of apple produced in the country or perhaps the higher competitiveness of Pakistani traders as they can buy cheaper supply at the farm gate level. However, because of low quality and poor value chain management, Pakistani apple gets only 56% of the world average export price in international market (Table 6).

Table 6: Comparison of world vs Pakistan's apple industry during 2016-2017.

Parameter	World	Pakistan	Share in the world (%)
Area (000 ha)	4934	78.3	1.59
Production (000 tonnes)	83139	588.1	0.71
Value of production (Million US$)	45849	310.9	0.68
Yield (tonnes/ha)	16.85	7.5	44.57
Farm gate price (US$/tonne)	551	529	95.87
Quantity of international trade (000 tonnes)	9044	0.767	0.0085
Value of international trade (Million US$)	7267	35.359	0.49
Export-production ratio (% of production quantity)	11%	0.11%	-
Export-production ratio (% of production value)	16%	11%	-
Average export prices (US$/tonne)	804	452	56.30

Source: Source: FAOSTAT Crop Production [http://www.fao.org/faostat/en/#data/QC] and FAOSTAT Trade, Crop and Livestock Data [http://www.fao.org/faostat/en/#data/TP]

The total volume of international export of apples is more than 9.0 Million tonnes having estimated value at US$7.26 billion in 2016. Pakistan exported 0.762 thousand tonnes of apples at an estimated value of US$ 35.4 Million during the same year, which is just 0.11% of total production in the country (Table 6). During 2016, China is among the top apple producing counties with a worth of US$1.5 billion apple export followed by USA (Table 7).

Table 7: Top apples exporting countries of the world (2016).

Rank	Country	Export (Million US $)	Share (%)
1.	China	1500.0	19.6
2.	United States of America	975.2	13.1
3.	Italy	970.4	13.0

4.	Chile	627.4	8.4
5.	France	591.4	7.9
6.	New Zealand	488.2	6.6
7.	South Africa	373.8	5.0
8.	Poland	344.3	4.6

Source: http://www.worldstopexports.com/apples-exports-by-country/

Pakistani apples are mainly destined to United Arab of Emirates. The volume/quantity of apple export can be enhanced by manifold but the main constraints are quality, sanitary and phyto-sanitary and other certification requirements. There some other important issues also exist which has been discussed in later sections.

From the above macro analysis of the apple industry, it is clear that apple value chain in Pakistan is not competitive in national and international markets. Despite the improvement in yield and production during the 2018-17 period, it still obtains 45% of the world average yield. The apple import has skyrocketed while export remains insignificant and highly variable. The apple export from Pakistan earns far lower price than the world average suggesting low quality and presentation of Pakistani apples in international market.

To make Pakistani apple competitive in national and international market, the Planning Commission of Pakistan has initiated this study to analyze the constraints and potentials, and suggest interventions along the whole value chain of apple industry to transform it into a competitive and viable industry in the country which can strive itself in international market and create income and job opportunities in rural areas. Such analysis is considered more relevant and effective if conducted for various apple cluster in the country.

2. OBJECTIVES OF THE STUDY

This study has been conducted under the Cluster Development Based Agriculture Transformation Plan –Vision 2025 project. The study objectives are given below:

a) To identify major apple clusters of Pakistan based on their production.

b) To characterize and conduct SWOT analysis of each apple cluster.

c) To identify infrastructure, institutional, technological, and policy fissures of each cluster.

d) To evaluate the real potential at various segments of apples value chain in each cluster.

e) To recommend infrastructure, institutional, technological and policy interventions to improve the competitiveness and viability of each apple cluster in the country.

f) To conduct economic and social feasibility of the suggested interventions.

3. METHODOLOGY

The macro data, field-level situation and other related information regarding characteristics, loopholes, potentials and required measurements for development of apple cluster were gathered from following sources:

1. **Macro data**. Macro data related production, trade, prices, etc. were collected from various sources including internet searches. See Annexure 1 for the list of data sources used in this study.

2. **Stakeholder discussion**. The primary data were gathered from field visits of farmers, individual and group discussions with farmers, researchers, extension agents, exporters, office bearers of farmer's associations, NGOs, and higher authorities. See the list of stakeholders consulted during the filed visit in Annexure 2.

3. **Literature Review**. Literature related to apple production, marketing, distribution, value chain development, and processing was extensively reviewed. See Annexure 1 for the literature reviewed in this study.

The following generic parameters and indicators were used in collecting the data:

1. Apple world industry perspective.

2. The apple industry analysis and its potentials.

3. Apples cost of production, harvesting, postharvest and processing of apples data were collected from farmers and other stakeholders.

4. Data were also collected from provincial directorates of Economics & Marketing, Postharvest & Food Technology, Wholesalers, Retailers and processers.

5. Production constraints, harvesting, transportation of apples, marketing issues, trading, export failures, and processing data was obtained from all the stakeholders.

6. The recommendations made on the basis of local and national and international parameters.

4. REVIEW OF LITERATURE

The bilateral trade between China and Pakistan is quite imbalance and in favor of global economic giant (China). That is why Pakistan has asked China to encourage its agricultural products into Chinese market, which will enhance one-sided contracted volume of trade from Pakistan side. The China-Pakistan Economic Corridor (CPEC) is a potential platform for both countries to benefit. China and Pakistan have principally agreed to widen agro based cooperation and adoption to fast-track trade in agricultural products (The News, 18th October, 2018). But, to meet the export targets, Pakistan has to apply the protocols under International Plant Protection Convention (IPPC), which is a major requirement for the export of agricultural products.

There is a trade war situation is prevailing between the two world economic giants and one of them is a very close neighboring friend to Pakistan and likely to be in need of Pakistani products especially agricultural products. The CPEC is one of the great opportunities for the destination of Pakistani products especially fruits, vegetables and dairy and poultry products. According to All Pakistan Fruit & Vegetable Exporters & Importers Association (PFVA) that Balochistan can export US$1 billion worth of fruits and vegetables annually. As Balochistan by area is about 44% of the country, the potentials are also in similar proportionate. As Balochistan is producing around 85% of apples of the country, therefore, PFVA in the start of last year visited Balochistan and held a series of meetings with the stakeholders for paving the way for the agricultural products of Balochistan including apples for marketing in international markets.

Our consultation with stakeholders concludes that Balochistan is called “The Fruit Basket of Pakistan” due to its five different agro-ecological zones, which enables it to produce variety of quality crops (around 75 different crops). Only one Zone out of six Zones is irrigated with canal system while the rest are dependent on precious-quality ground water. However, persistent drought for last 3 decades has played havoc with the agriculture sector of the province. On other hand, untrained farming community to use modern technologies with low education profile has further aggravated the situation by over extraction and injudicious use of this precious source. Besides other crops apples, which is regarded as high water requiring crop, has severely been affected. The experts are of the view that the current situation can be improved by introduction of high efficiency irrigation systems which will increase the agriculture both vertically and horizontally i.e., productivity and area respectively.

During the consultation process, the apple farmers expressed their concerns that besides water scarcity, apple pests are also posing great threat. The major apple pests reported in Balochistan are Heliothis, codling moth and spider mites, which sometimes cause several sprays on this precious crop. Thanks to dry climate of most of apple growing areas, no major disease has been mentioned by apple growers. However, measures on biological control of major pests of apple crop are being undertaken in Balochistan where 85% of apple crop is concentrated. These interventions are in progress at Balochistan Agriculture Research Institute, Quetta with the collaboration of Center for Agriculture and Biosciences International (CABI). Their research work

on these major pests has resulted in many successes, which will indeed minimize the use of chemical sprays on apple crop.

Apple fruit is subjected to 30-40% postharvest losses which is great loss to farmers of this crop (Ilyas et al., 2007; Munawar et al., 2018). The magnitude of these losses are further aggravated by selection of inappropriate apple variety for an area. The color of apple skin is one of the important attributes, which is severely affected by high temperatures resulting in inferior or discoloration (Yoshiko, 2015).

Pakistan apple industry is also facing issues of technical expertise about production technology. Another important factor for the production of quality apples is optimum chilling requirements, which is always undermined by the apple growers at the time of selection of varieties. Furthermore, research capacity, extension capabilities and farmers' agriculture literacy is needed to be enhanced for good agriculture practices. It has also very rightly been mentioned in the first ever National Food Security Policy document of Pakistan that development of clusters of more than 40 high value commodities (including apple) are imperative for producing diverse high value products to reduce post-harvest losses, increase off season availability and promote rural business in potential production zones including CPEC (Government of Pakistan, 2018c).

4. CLUSTER IDENTIFICATION AND CHARACTERIZATION

4.1. Identification of Clusters

In Balochistan, apples are grown in the Central and Northern parts of the province (Figure 1). Out of thirteen districts of Balochistan, apple is grown in 17 districts, with wide differences in the average yield/ha (Table 8).

Figure 1. Map of Pakistan Showing Apple Production & Marketing Areas

Apple production in Balochistan can be divided into two clusters:

1. **Northern Cluster** which consists of four districts namely Killa Saifullah, Zhob, Ziarat and Loralai with a focal point of Killa Saifullah. The Northern Cluster contributes about 68% of the provincial apple area (Table 8). The district of Killa Saifullah is considered as the focal point of the Northern cluster because it is the top apples producing area of Pakistan both in terms of area and production. This district is alone producing about 50% of apples of the Balochistan province and 42.22% of the whole country. The district is also surrounded by other apples producing districts, i.e., Zhob, Ziarat and Loralai (Table 8).

2. **Central cluster**, which consists of five districts namely Mastung, Pishin, Killa Abdullah, Kalat, and Quetta with Quetta as its focal point. This Cluster contributes about 29% of the

provincial apple area (Table 8). Although Quetta contributes only 2.5% of the provincial apple area it is considered as the focal point for the Central cluster because of its central position in marketing as most of the apple in the province pass through Quetta market. Moreover, central research and extension related offices are located in Quetta, especially for fruits and vegetables.

Table 8: Important district and regions for apple production in Pakistan during 2015-16.

	District/Location	Area (ha)	Production (tonnes)	Production (% of provincial production)	Yield (kg/ha)
Northern Cluster of Balochistan					
1.	Killa Saifullah	24,950	261,975	49.7	10,500
2.	Zhob	6,324	59,237	11.2	9,367
3.	Ziarat	1,966	25,200	4.8	12,818
4.	Loralai	1,550	10,932	2.1	7,053
Total Northern cluster		34,790	357,344	67.7	10,271
Central Cluster of Balochistan					
1.	Mastung	6,542	65,073	12.3	9,947
2.	Pishin	3,679	33,240	6.3	9,035
3.	Killa Abdullah	2,967	26,151	5.0	8,814
4.	Kalat	2,200	17,231	3.3	7,832
5.	Quetta	1,471	13,312	2.5	9,050
Total Central cluster		16,859	155,007	29.4	9,194
Other important apple growing regions					
1.	Swat	3,750	28,660	33	7643
2.	FATA	2,448	49,625	54	20272

About 15% of the apples produced in the country are coming from Khyber Pakhtunkhwa including now defunct FATA areas. However, as noted earlier, the apple production in KP and FATA is on the steep declining trend because of the increasing competitiveness of peaches in Swat and FATA. Moreover, it is on record that new germplasm of apple and other deciduous fruit was introduced in various districts of Balochistan and Khyber Pakhtunkhwa. Thus, the latter does not have very different agronomic and economic characteristics than those in Balochistan. Therefore, we did not consider apple areas in these regions as vibrant apple growing cluster.

Similar declining apple production trend was found in Gilgit-Baltistan because of improving competitiveness of other crops especially apricots and cherries, although GB apples plantation has an advantage of its proximity to CPEC main high and can be future potential apple growing cluster, if its productivity and quality issues are resolved. Most of the apples areas of GB are not grown systematically i.e., no proper orchards layout is carried out due to non-availability of big

piece of lands in the world's highest mountains ranges. Moreover, it is on record that new germplasm of apple and other deciduous fruits were introduced from Balochistan to GB thus the latter does not have very different agronomic and economic characteristics than those in Balochistan.

Although significant area is under apple cultivation in Swat, FATA, and Gilgit-Baltistan (GB), but as mentioned earlier apple area in KP is on steep decline The KP and G-B apple clusters are not included for further study and cluster development interventions.

5.2 Characterization of Clusters

A detailed comparison of both the clusters identified above is presented in Annexure 4. A brief description of the comparison of these clusters is given here.

Most of these areas cultivate quality of local and exotic apples, which possess unique aroma, colors, sizes, shapes and tastes. This diversity in produced apples of Pakistan is yet to be exploited through indigenous research and exploring of neighboring international markets for export purpose. Around 85% of apples production is concentrated in Balochistan and its areas are well concentrated around the main proposed CPEC Western route. So, there in future high demand apple for want of local produced apples versus imported apples will create a competitive environment for local apples growers. It is also a matter of fact that some farmers just follow the market trends instead of keeping in view the climatic, soil, scion and rootstock compatibility, cultivar's chilling hour requirement for cultivation of quality apple crop. The height of apples growing areas in Pakistan is from 1,411 to 25,543 meters from sea level, which is suitable for apples cultivation but each height is suitable for the cultivation of certain apple varieties.

Apple was introduced in Central and Northern Clusters by more than 100 years ago. Apple was given special attention due to its great potential, in the beginning of 1980s by execution of a project entitled "Deciduous Fruit Development Project" by the Balochistan Agriculture & Cooperatives Department through Agriculture Research Institute, Quetta and Food and Agriculture Organization (FAO).

A large number of apple varieties are grown in both the clusters, which include Red Delicious (*Tur Kulu*), Golden Delicious (*Shin Kulu*) are relatively more famous varieties for their attractive color and taste throughout Pakistan especially the later one for its extended shelf life. Apple is a major crop in both clusters as it occupies 28.59% and 26.43% of the cropped area in Northern and Central clusters, respectively. The Northern Cluster is the key apples growing region with the highest production and famous for the best quality apples. Higher altitude, low temperature both during winter and summer, which fulfill chilling requirements and favor best color development in apple skin, are best suited to this crop in both clusters. Most of the apple growing areas of Central Balochistan Cluster are relatively at lower altitude, however, geo-strategically better situated concerning CPEC.

The Northern Cluster of apples is the key and top cluster in terms of both production and area of Pakistan. The climatic conditions of the Northern Cluster suit best to apple crop and that is why several varieties thrived well and became cultivars. Now, this crop has become an industry, which has engaged thousands of farmers, laborers, traders and allied service providers and have become the main source of living to the people engaged in this crop.

The cluster produces quality apples and most of harvested crop is marketed in other parts of the country however, marketing costs of this crop are very high. No enterprise has been established for collection of fruit in bulk and market the small volumes from large number of local farmers. No farmers' organization exists to manage inputs in bulk like pesticides, fertilizers, packaging materials, branding, transportation of their produce, and marketing.

Despite persistent drought, the cultivation of apples is increasing in the cluster areas but the cultivation method is still conventional. Even the inefficient irrigation methods of flooding have not changed. There is no soil testing facility in the area, nor farmers are aware of its' utility in making input decisions.

Fertilizers are used injudiciously and the quality of fertilizer is also compromised. Fresh semi-decomposed cow dung is used in large quantities. Some agriculture scientists believe that instead of any benefit from this practice, it may invite pests that may destroy the roots of the trees resulting the loss of bearing of young trees. As preemptive measures farmers spray their orchards without pest scouting which sometime may result the loss of money and effort.

Most of harvested crop in the Central Cluster is marketed in other parts of the country mainly cities of Sindh like Karachi, Hyderabad and Sukkur. The crop is main source of living to people engage in it but for last few persistent drought years has caused a looming fear among farmers. The effects of drought can be seen in died or dead apple orchards of the cluster.

5.3 Value chain of apples

Conventional farm management practices are applied to apple tree from nursery preparation to harvest. Except few farmers, fertilizer use if any is imbalance. Fresh cow dung without its proper decomposition is normally applied and 2-3 sprays are given every year. Intercropping of apple orchard with other crops are common. Winter pruning is done by cutting the dead branches, but pruning is generally considered loss to tree vigor, and summer pruning is not practiced.

Harvesting is manually done and higher apple percentage is lost during harvesting. The fruits are purchased by contractors and commission agents/wholesalers. Large farmers directly bring their produce in the market for auctioning. Retailers and exporters do grading according to the market demand.

Most of the produce of both the clusters in Balochistan is destined to other parts of Pakistan and some is exported. The apples from the Central Cluster of Balochistan are marketed in Karachi,

Hyderabad and other markets of the country, while the apples from Northern Cluster mainly go to Islamabad, Lahore, Multan and other northern part of the country. Apples from KP, AJK and GB are mostly marketed in Islamabad, Lahore and Peshawar markets.

Apples are traded and consumed fresh. Apples are mostly packed in wooden crates or sometime corrugated cartons and transported through open trucks and pickups. No value chain or processing facility is available in apple clusters. Only one project (Pakistan Agriculture Cold Chain Development) on cold chain worked in Northern Cluster that established a very few on-farm and commercial cold storages on cost sharing basis which accommodates small quantity of apples.

Research and extension on apple, especially on its value chain aspects, are very weak. Certified nurseries with certified mother block are lacking in the cluster areas. No concerted efforts were made to renovate the old low yielding big apple trees with new high-yielding apple varieties.[2]

5.4 SWOT Analysis

5.4.1. Overview

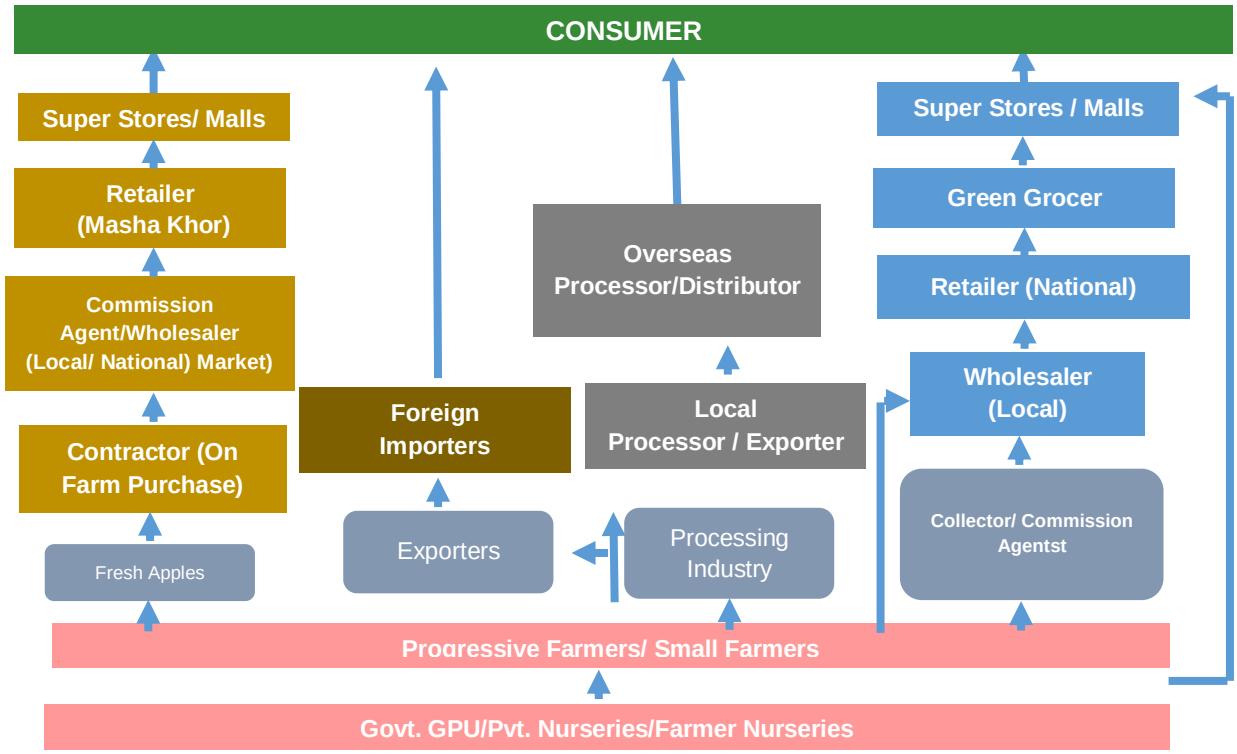
The SWOT analysis was conducted during the consultation meetings in major apple producing areas in presence of different stakeholders of apple crop. The results of SWOT analysis are based on the consultative discussions with apple farmers, all the stakeholders involve in the different segments of value chain, inputs, production, storage, and marketing. The strengths and opportunities were also looked at and in similar way weaknesses and threats have also been combined for better understanding.

5.4.2. SWOT Analysis for the Clusters

The SWOT analysis is carried out in focus group consultation conducted in major apple producing areas with the participation of different apple stakeholders along the apple value chain. The results are organized around the value chain functions, including inputs, production, storage, and marketing. The detailed SWOT analysis is presented in Annexure 5, and brief summary of the analysis is presented below.

[2] This can be done by first creating the space for new plants by pruning the old trees, and when new trees area near fruiting, gradually replacing the old trees with the new plants if it is necessary.

Figure 2: Description of Apple value chain in the Balochistan cluster



Both the Central and Northern clusters have many strengths and opportunities for the cultivation of variety of apples. The experience of apple cultivation by the farmers of this cluster is one of the great strengths, which is needed to be exploited by employing all modern production technologies of apple crop. The cold and dry climate is also one of the advantages that do not allow diseases to proliferate. Difference in day and night temperature induces the most desirable consumer's parameter i.e., apple fruit skin color which aids the human body defensive mechanism. This cluster lies in the center of the country and at liberty to market its product in either ends of the Pakistan. Major weaknesses are lack of planning, no familiarity with modern production technologies, and post-harvest handling of apples. These factors always undermine the whole investment and labor the farmer exert for apple cultivation. No or less investment in apple oriented research and development has been made. Indigenous technology development, breeding programs, extension work and marketing has always been neglected. The biggest threat is persistent drought followed by climate change, insect infestation, and this situation is further made worse by absence of cold chain, value addition, energy shortage and unfair trading practices. These all factors hinder the development of this very important crop, which is livelihood and mainstay for the farmers and other stakeholders in Balochistan.

6. CHALLENGES FACED BY THE CLUSTERS

6.1. Climate Change and Shortages of Water

Both the apple clusters of Pakistan are identical in many ways while differences in opportunities do exist. The foremost similarity is climate that suits apples cultivation therefore, apples cultivation has become a culture in most areas of these clusters. Most of the areas in these clusters are growing apples for more than a century. But, after such a long cultivation experience, these clusters still could not overcome the production and quality issues faced by the apple industry.

One common challenge for apple clusters imposed by the nature is water scarcity. In apple growing areas of Balochistan availability of irrigation water is major hindrance in production and development of two major clusters of Pakistan. Whatever the water is available, it is precious ground water which is extracted from more than 1,000 feet in Ziarat and Kan Mehtarzai areas) which has high extraction cost and increases the production cost. For significant development in apples industry, it is imperative to introduce high efficiency irrigation system, dwarf apple rootstocks, new varieties and introduction of solar system for water extraction. The fear is common among all the stakeholders of Balochistan that without proper regulation on using underground water, the solar energy system will extract all the remaining aquifer water.

6.2. Constraints at Production Level

The promising apple clusters of Pakistan have been introduced with several new and exotic apple rootstocks and varieties by different provincial agriculture wings but at farmers' fields, a few varieties are available. With the passage of time, the apple trees of old varieties lose their yield and quality potential. Replacing these with new trees of emerging high-yielding variety is very essential not only to increase the orchard yield but also to keep up with market demand. However, currently there is no mechanism of renovating the old gardens.

After the implementation of 18th constitutional amendment, agriculture like many other departments has also become a provincial department. Therefore, the Agriculture Departments has the responsibility and mandate to prioritize the research and development for the betterment of poor performing apple industry. Currently research institutes receive very little operational budget, which seriously constraints already understaffed researchers in these institutes (Table 9).

6.3. Post-harvest losses

The high perishability of apple fruit is one of its most limiting factors. About 40% postharvest losses occur in apples. If pre-harvest losses are also included, which are in shape of fruit drop especially the June drop in apples, de-shaped and infected fruit, which are left in the orchard or sorted out during packaging, the losses can go up to 50%. At packing stage, a considerable amount of fruit is discarded which is 5-10% (inclusive of pre-harvest loss of fruit drop).

Table 9: Gaps and Constraints at Production Level.

	Parameters	Central Cluster	Northern Cluster
1.	New germplasm	Difficult to access	Difficult to access
2.	Mother nurseries or Germplasm Unit (GPUs)	Very few	Very few
3.	Orchard size/type	Large, medium and small size orchard all exist in the cluster	Large, medium, and small size orchard all exist in the cluster.
4.	Certified plants	Limited availability	Very limited availability
5.	Research	Qualified staff but lack of funds in the public sector. No research on value chain aspects in the public and private sector	Qualified staff but lack of funds in the public sector No research on value chain aspects in the public and private sector
5.	Extension services	Moderate	Moderate
6.	Commercial inputs	Suboptimal and imbalanced use, especially of micronutrients	Suboptimal and imbalance use, especially of micronutrients.
7.	Labor input	Hired and available	Hired and available

The postharvest losses begin from pre-harvest that is due to selection of wrong variety for an altitude, which results in low quality fruit production. Such produce does not attain full skin color and aroma size and ultimately results in low returns to farmer. Furthermore, these fruits are subject to further deterioration right at the time of harvest at the hands of unskilled labor. After this, the fruit is also not handled properly during the transportation and marketing processes such as retailing.

6.4. Constraints at Value Chain Level

Keeping food items at low temperatures or freezing them is one of the oldest methods of food preservation and widely used to preserve quality, taste, texture and nutritional value. However, apples are mainly marketed fresh and without any cold chain. There is no cold chain from farm gate to market and even there is no concept of cold storage at farms. The quality of apples in the country are manually graded and packed. Apples are required to be stored at 0±0.5°C and same

temperature is also required during transportation, while it is transported in open truck from both the clusters. As the nation becomes wealthier, the demand of quality intact food is increasing, therefore, this is high time for more investment on infrastructure and research on apples value chain. At present farmers pack their apples in wooden boxes or corrugated cartons even in sacs placed on roadsides for sale (Fig. 3) while, most of the farmers and traders skip the important processing, washing, drying, grading, packaging, transportation protocols and without any labeling and trade mark. In the absence of these technologies, it is not possible to maintain the quality and standards of apple crop. The majority of apple farmers in Pakistan are poor and have low education profile. Adaptation of said technologies in the existing apple industry in the country is difficult. The public sector cannot do this alone. The private sector and NGOs should come forward for the development of value chain infrastructure and for the introduction of new technologies. For this purpose, incentivizing the apple industry would also be imperative.

In both these clusters the marketing and processing of apples is largely done individually. No collaboration and horizontal integration between the growers, processors, or traders exist to meet the big orders or capture potential apple markets abroad. As a results, export of apples is very limited and processors compete for customers within the country.

Figure 3: The Sale Conditions of Apples in Balochistan

6.5. Constraints at Trading Level

The handling and storage facilities for apples are not sufficient to meet the international standards. Therefore, very little quantities of apple pass through cold storage facilities in Balochistan (both in Central and Northern clusters). In the Balochistan clusters, formal regulated marketing system do exist where traders are bound to carry on their businesses under the licenses issued by the authorities. In the two clusters, there are opportunities for trading apple under the regulated system established by the Government of Balochistan. Recently, the government is trying to establish fruit and vegetables markets at district level across the province, which will create healthy environment for apples marketing.

Naturally, traders strive to earn the highest margins by buying at the lowest prices and selling at the highest prices. However, very little attention is paid to product differentiation and quality aspects to achieve premium prices. Communication technologies and internet services are easily obtainable but no Marketing Information System (MIS) exist. Labor is available on a permanent or casual basis. Financial services are provided by both formal and informal banking institutions to traders active in fruit and vegetables markets (Table 10).

Table 10: Gaps and Constraints at Trading Level

	Parameter	Central Cluster	Northern Cluster
1.	Marketing channels	Traditional/some areas regulated	Traditional/some areas regulated
2.	E-commerce platforms	Not available	Not available
3.	MIS System	Does not exist	Does not exist
4.	Contract farming	Yes	Yes
5.	Export readiness	Exist at limited level	Does not exist
6.	Quality differentiation	Very limited	Does not exist
7.	Certifications (phytosanitary)	No	No
8.	Branding	Limited	Limited

7. CLUSTER DEVELOPMENT POTENTIALS

7.1. Overview

The strategic locations of these two clusters are very important and benefits should be gained from their strategic locations along the CPEC routes. The Central and Northern clusters are on CPEC route to Gwadar, Middle East and Central Asia, which can make Pakistan a hub for trade in apple and other commodities. The clusters lying in Balochistan has the capability to expand both vertically and horizontally due to availability of plenty of land along with favorable climatic conditions, existence of main highways road network, round the year availability of labor, clean and diseases free environment etc. In this section, an attempt has been made to evaluate the potentials in apple clusters in terms of higher production along with improvements in the quality as well as in the value chain using the targets set in Section 2. Both quantitative and qualitative analyses are presented to explain the nature of potentials of the apple value chains in the two main clusters of Balochistan province.

7.2. Potential of Expanding the Production

As noted earlier, the current apple yield of around 6.8 tonnes/ha in Central Balochistan and 10.5 tonnes/ha in Northern Balochistan is much lower than the world average of 16.8 tonnes/ha. Many other developed apple producing countries get even much higher yield than world average. For instance, the yield of apple in Italy falls at 44 tonnes/ha while in Chile, it is 36 tonnes/ha.

Both the provincial and federal Agricultural Research Institutes present in Balochistan work to increase productivity of apple orchards in the province. Many advanced management technologies, such as pruning of existing garden, balanced use of fertilizer, properly decomposed manure, etc. and improved apple varieties such as Red Delicious (*Tur Kulu*), Golden Delicious (*Shin Kulu*) and Amri already exist which can easily double the yield. If only 30% increase in yield is assumed through concerted efforts of promoted these technologies to farmers' field, it can generate more than US$ 34 Million and US$ 35 Million in the Central and Northern apple clusters, respectively. In addition, researchers in Balochistan have shown that high-density apple garden with drip irrigation along with appropriate management practices (pruning, balanced use of fertilizer, etc.) can increase the current apple yield by up to 200-300%. If we renovate only 15% of the orchard and assume 100% increase in yield, it will bring more than US$ 6.8 Million and US$ 13.7 Million additional revenues to the farmers in the Central and Northern apple clusters, respectively. In addition, it can generate hundreds of additional jobs in the respective cluster.

The question is where to absorb the additional production? It is very encouraging that during the last one decades or so the apple production in the country has phenomenally increased and almost all of this production was consumed within the country. This can be attributed to economic growth, rise in per capita income, urbanization, developments in food production system, storage, packaging and preservation methods, changes in food preferences towards high value products, etc. It is expected that the strong positive trends in the consumption of fresh apple will continue for couple of decades in the future, hence, there is tremendous scope of expanding the domestic market of apple.

7.3. Enhanced Processing

Apple juices in urban and rural areas in the world as well as in Pakistan is another emerging market. Our discussion with consumers and limited retail market survey suggest that apple juices are preferred by the consumers in Pakistan if they are supplied at affordable prices. At international level, revenue in the apple juice segment amounts to US$15.375 billion in 2020 and apple juice consumption is expected to increase at the rate of 3.3% per annum in coming years (Statista, 2020). Although no data is available on apple juice consumption in Pakistan, but it is generally believed that apple juice consumption in the country is quite high. Most of the consumption, however, is at the household level filled by domestically extracted juice. This demand can be harnessed by the commercial sector by supplying apple juice in convenient packing throughout the year.

Hence, there is a considerable scope for introducing juice-making activities (as cottage industry) in apple producing clusters of Balochistan. Bringing 10% of fresh produce in each cluster will bring nearly US$22 Million and US$19.5 Million to processors in the Central and Northern clusters, respectively. It will reduce the post-harvest losses, generate additional employment in both the clusters, and ensure apple juice availability at reasonable price throughout the year.

7.4. Harnessing apple trade potential

As noted earlier, the demand in fresh apple worldwide has increased at the rate of 2.4% per annum during 2000-2016, whereas at the domestic front, its consumption has also increased at much faster rate. This clearly implies that both apple clusters of the province can benefit relatively more by targeting domestic demands rather than jumping on export. This will save the valuable foreign exchange spent on apple imports.

7.5. Reduced Post-Harvest Losses

Producing a good crop of high-quality apples requires time, skill and money. To gain full benefits from the crop, it is important to sustain the quality of the apple until they are delivered to the consumers. Proper post-harvest cooling and careful attention to handling can prolong the time

during which they remain fresh and marketable, thus reduces the post-harvest losses. The researchers believe that with the adoption of appropriate harvesting and post-harvesting technique, the post-harvest losses can easily be reduced from 30% to 15%, which will save more than 33 thousand tonnes and nearly 60 thousand tonnes of production and generate more than US$ 23.23 Million and US$41.50 Million of revenue in the Central and Northern clusters, respectively.

7.6. Improvement in Value Chain

The apple value chain in the country is undeveloped, which not only results in lower price of the apple produce and high post-harvest losses. Selection of appropriate variety at the given altitude, keeping the apple fruit at proper temperature until it reaches to the consumers, applying proper harvesting techniques, removing field heat before transporting, proper packaging, fork bases loading and unloading, use of appropriate vehicles can significantly improve the quality of the fruit to the satisfaction of the consumers. Appropriate measures at the value chain level along with appropriate commercial strategies and incentives, to be explained in the next section, cannot only boost export but also the apple prices in international market. We believe that Pakistan should be able to fetch at least an average of international export price, if not more. This will bring US$ 7.695 Million and US$ 13.743 Million as additional foreign exchange earnings in the Central and Northern apple clusters, respectively. Similarly, the quality of at least 10% of the domestic apple produce will be improved equal to the average international export quality. This will bring a total of US$ 3.857 Million and US$ 6.888 Million to various stakeholders in the Central and Northern apple clusters, respectively.

In summary, lot of potential exists in the apple industry to expand vertically as well as horizontally. For this, it requires investment in the research and development, quality infrastructure for value chain improvement and processing, which are being identified and quantified in the next sections. This will not only transform agriculture but also improve socio-economic condition of farmers and generate employment in rural areas.

8. PLAN, POLICIES AND STRATEGIES

8.1. Plan

After analyzing the potential of apple value chain, and discussion with appropriate stakeholders especially researchers and extension agents, the following targets were fixed for a development project of five-year duration (Table 11).

Table 11: Targets of apples cluster plan.

	Targets for Apple Cluster Development
a.	Increasing per ha yield of apple by up to 30% in Central Balochistan and 15% in Northern Baluchistan cluster over the project period
b.	Reducing post-harvest losses from 30% to 15%
c.	Improve the value chain of the additional production so that it can fetch the price at least equal to the average international import price.
d.	Increase apple processing up to 5-10%.

We believe these targets are achievable if appropriate policies and strategies are adopted which are suggested in the coming section. To implement these policies and strategies, investment would be required by the public and private sectors which are identified and their economic viabilities are estimated in Section 9.

8.2. Policies

It is imperative to set an agriculture policy that guide both the public and private sectors for investment in different apple related industries and business and provide regulatory environment for infrastructure development. First of all, government needs to give big push to research in the public and private sector so that it can supply new emerging efficient technologies along the value chain. The government sector particular supply new germplasm and semi-finished varieties to the private sector who can develop final varieties suitable for different apple clusters in the country. Special incentives should be provided to encourage value chain apple research in the private sector.

For development of apple clusters, besides improvements at field level and value chain development, MIS for provision of information on trends in national and international market is very important for farmers and other stakeholders. This will create competitive environment among the apple industry stakeholders, which will lead to the enhancement of production, quality and developed value chain of the product.

The power shortage is a common and big obstacle for the processing of apples in both the clusters. For the development of processing segment, a diversification strategy is very necessary to develop new products and markets. For trading in higher-value fresh apples domestic and international markets, it will be necessary to develop facilities for packing, cold storage and refrigerated transport.

8.3. Strategies

To achieve the above targets following strategies would be adopted.

8.3.1. Strengthening the Research on Apple

Research plays a leading role in apple value chain development. It can generate new high-yielding varieties, appropriate management practices in production, processing, and marketing. It can also help in capacity building of stakeholders. Because Baluchistan is the major apple growing area in Pakistan, therefore, it is suggested to establish Apple Research and Development Center (ARDC) at Agriculture Research Institute, Sariab, Quetta. The Center should be an autonomous body under the Board of Directors chaired by a prominent apple scientist and members taken from the private sector. The Center should collect and distribute apple germplasm of various characteristics to public and private sectors in other provinces especially KP, Gilgit-Baltistan, and AJK, undertake research on issues related to the whole value chain, generate information about apple marketing in domestic and international markets and new emerging technology trends. Target oriented research should be encouraged. The KP, GB and AJK should have their own research station guided by the ARDC in Quetta.

8.3.2. Organization of Farmers Entrepreneur Groups

Farmers Entrepreneur Groups (FEGs) can play important role in helping farmers to overcome the economies of scale issues, collect investments from small farmers for processing and value chain infrastructure, capacity building of farmers, and start contract farming by ensuring value chain. To establish the FEGs following suggestions are made:

- Farmers Entrepreneur Groups will be organized at union council level in apple growing areas with the help of NGOs like NRSP who have main focus on social mobilization.
- Basic infrastructure like apple pack-house, apple juice manufacturing units, etc. will be incentivized through FEGs.
- Management of the processing infrastructure will be through a hired manager by the FEGs selected through consensus but initially paid by the government.
- All incentives like concessional loans, capacity building training, etc. would be channeled through FEGs.

- The members of the groups will be trained as demanded by the majority of FEGs. They can pick any or all of the training modules including good agricultural practices, IPM, protocols for apple juice making, etc. These modules will be developed by the specially hired experts for this purpose.
- The groups will be encouraged to start quality- and fixed price-based contract with apple traders. The main responsibility of FEGs would be to ensure quality of apple.

8.3.3. Renovating the Existing Apple Orchards

At present, the inter-plant and inter-row distances are quite large. On average, 250 apple trees per ha are planted in the area. It is proposed to replace these with high-density ones by planting more productive trees of modern varieties having smaller canopy in inter-plant space available, after pruning the old trees which will create additional space for the new trees to flourish. The P×P and R×R distance shall be 10 feet with installing trellises for providing support to new plants and the drip irrigation system (Annexure 3). In this way, the number of plants per ha shall increase by nearly 4 times while almost same amount of irrigation water shall be applied but with drip irrigation, less water per plant will be used. It has been assumed that an encouraging response to this intervention shall come from the farmers. For this purpose, the following measures needs to be taken:

- Signing of Memorandum of Understanding with countries like Italy and Chile for research collaboration and germplasm exchange.
- Establishing mother orchard at provincial agricultural research institutes and private nurseries having good business reputation.
- Providing financial support to private nurseries in producing certified nursery plants of modern imported varieties to the farmers.
- Providing financial support to the farmers in renovating their orchards with high-density plants on 50:50 cost sharing basis.

8.3.4. Yield Improvement by Better Management Practices

At present, apple farmers of the area are following decades old orchard management practices. Demonstrating and educating farmers about the impacts of improved management practices on yield and quality. This objective can be achieved by activating public agricultural extension department and the agricultural advisory services shall result in adopting modern improvement management practices. For this, the following measures needs to be taken:

- Educating farmers for applying farmyard manure and recommended doses of fertilizers.
- Organizing training of the farmers and service providers in modern methods of orchard pruning, especially the apple orchards.

- Application of weedicides and weeding the orchards on regular basis.
- Applying sprays of recommended chemicals, when and wherever needed.
- Developing schedule of drip irrigation based on the soil, climate, etc.

8.3.5. Management of Harvest and Post-Harvest Losses

.Quality of fruit can be ensured at the harvesting stage which can be maintained throughout the value chain. Selection of appropriate variety at different altitude and harvesting at the correct time using appropriate harvesting techniques are essential to produce good quality apples.

The storage life of the apple ranges from 1 month to 12 months. To ensure maximum storage life, apple should be harvested at its proper maturity stage. If harvested before they are matured, apple will have poor eating quality, become susceptible to storage disorders such as scald, cork spot and bitter pit, and may not ripe properly. Ripe fruit should be avoided because it will continue to ripen in storage, rapidly becoming too soft and mealy after sale. Firmness and level of soluble solids in the apple are good indicators of maturity to use in determining picking time.

Apples are also very susceptible to bruising and other forms of mechanical damage and therefore, should not be handled unnecessary. Workers harvesting apples should be cautioned not to drop them or handle them roughly. The effects of bruising and scuffing cannot be reversed. Damage from rough handling will accelerate deterioration, increase respiration, and reducing the value of the product. Therefore, it is very important to educate farmers that they should handle apple fruit with utmost care.

Apples are normally transported and stored in bulk boxes filled in the orchard. Boxes should not be allowed to be placed for extended periods under direct sunlight for more than few hours before cooling is started. These also should not be overfilled. When overfilled boxes are stacked, many apples are bruised in the box. During storage, the boxes should be kept clean and have adequate air circulation and water drainage. Five to 8 percent of the lateral surfaces and 3 - 5 percent of the bottom should be open. Better circulation can be provided by making many small, well-distributed holes in the box than a few large ones.

At present, apple is manually harvested and the payment is made to the labourers on the basis of quantity of apple plucked in a day. Therefore, the harvesting labor pick both the mature and immature apples. Moreover, they do not care about picking the diseases/damaged ones. They try is to harvest as much quantity as they can. Secondly, the pre-harvest contractors also do little sorting/grading and attempt to hide the immature ones at different levels in the box, before shipping to different destinations. Thirdly, the size of the boxes is also quite big resulting into fruit damages (pressing and bruising) during transport to different markets of the country. All this results into the loss of a high proportion of fruit in the supply chain.

Under the improved post-harvest management practices, the harvesting labor shall be trained in better harvesting methods by educating them about the signs of appropriately mature fruit and the payment method shall also be changed from quantitative to grade-based harvesting method by raising their harvesting charges. Moreover, the fruit packaging method shall be changed from large sized, multi-layered packing in wooden boxes to two-layered paper boxes, and shifting to the use of appropriate filling material and aeration in it rather than resorting to filling it with straw and waste papers of the newspapers. Moreover, improvement in grading (size and maturity based) shall also be practiced. It is assumed that market shall also positively respond to these practices by offering relatively higher prices for the better graded and packed apple than those packed in conventional wooden boxes.

In this regard, the specific measures need to be taken are:

- Organizing trainings of the apple harvesting labor to teach them about the stages at which the apple should be harvested and how it should be picked.
- Ways and methods of practicing proper picking and grading and necessary cares needed in handling the harvested produce.
- Providing support for establishing packaging industries within the clusters, so that the packing material is available at relatively cheaper rates.
- Providing support to service providers in refrigerated transport and forked loading and unloading.

8.3.6. Promoting Cottage Juice Making Industry

The potential markets for apple juice have been identified in the previous section. The following strategies are suggested to promote processing of fresh apple into apple juice as a cottage industry in rural areas:

- The cottage level apple juice making activity shall be consisted by establishing small units of 50 juicer machines in each unit along with due gadgets (e.g. tubs, chillers, etc.) for storing/ refrigerating the juice, and initial preservation treatments. These units will be established at union council level and own and operated by FEGs.
- Collection of apple juice manufactured in rural areas and its packaging should be encouraged as an industry in peri-urban areas. The established firms will market the packed juice and distribute it to various destinations of the country throughout the year and abroad under its own brand.
- For Small scale cottage industry in rural areas and for collection and packing of juice in peri-urban areas, due financial support should be provided to the developers of the apple processing units in the form of interest free loans.

- Training and certification of apple juice makers in food safety and quality management system so that SPS certified apple juice is available from the cottage industry in the apple cluster areas.
- Introduction of GI (Geographical Identification) registration and certification in the apple cluster areas of Balochistan.

8.3.7. Improvement in Apple Value Chains

In Pakistan, our discussions with stakeholders suggest that about one-third of fruits and vegetables is lost during transport from producer to consumers, negatively affecting the compatibility of the produce. Prices are decreased due to due to poor post-harvest management practices such as absence of modern storage and transportation facilities, improper packaging and transportation, etc. Lack of proper marketing infrastructure, horticultural products are also subject to big losses and seasonal fluctuations. In the value chains improvement context, several measure like formation of Farmers Entrepreneur Groups (FEGs), contract farming through FEGs, farmer' integration with the super markets and other large scale retail centers, introduction of cold transport facilities, fork-lifts for loading/un-loading and weighing machine should be used.

A collection center in the major apple growing union councils shall be established where basic infrastructure like graders, packaging material, the hydro-cooling method for removal of field heat (Box-1), small cold storage, fork lifts for loading/unloading and weighing machines, etc. shall be introduced so that the quality apples are supplied from these collection points to the domestic and international markets. These collection centers should be established on cost-sharing basis between the government and FEGs of the apple producing union councils.

The specific measures suggested are:

- Support FEGs to build collection centers and pack houses at cost-sharing basis which are equipped with improved post-harvest facilities like hydro-cooling for the sinking of field heat (Box 1), cold storage, washing, grading and packaging facilities. Moreover, fork-lifter based loading/unloading approach may be adopted. The collection centers may also have trading/auction facilities.
- Government should provide management support to each collection center and pack house facility. These facilities can also be used for other fruits and vegetables coming from the member farmers of the FEGs. Each services provided by the center should be charged. The profit of the facilities should be shared between different members of FEGs proportionate to the investment in the center.
- Combined learning of Good Agricultural Practices (GAP) at the FEGs level.

- Certification of GAP and quality insurance at the group level by FEGs.
- Use of refrigerated transport vehicles for carrying apples instead of conventional trucks.
- Use of attractively printed cardboard boxes of relatively less weight than the wooden boxes and having good aeration.

Box-1: Post-Harvest Cooling and Handling of Apples

Removal of field heat before storage and/or sending to various destinations is very important for value chain improvement. One of the quickest methods of removing field heat from apples is hydro-cooling[3] (Figure 4). This process can be accomplished by washing/flooding the fruit with large volumes of chilled water, normally in hydro-cooler designed specifically for that purpose (Figure 5). Moreover, the various fungicides and scald inhibitors can also be applied during hydro-cooling. It is not advisable to remove all the heat by hydro-cooling alone. Washing with water having temperature around 45°F (or 7.2°C) is best and later on the fruit should be kept at around 32°F (or 0°C). In general, as the diameter of the apple doubles, so does the length of the time required to cool it. This means that large apples need to be hydro-cooled longer than the small ones.

Figure 4: Rate of Temperature Change for Three Methods of Cooling

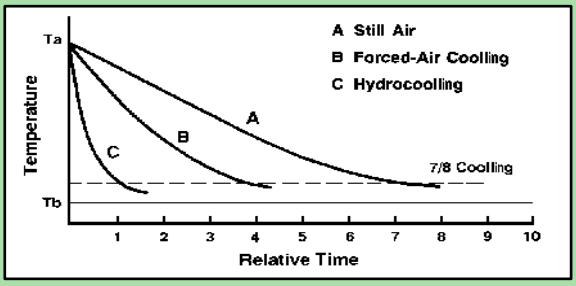
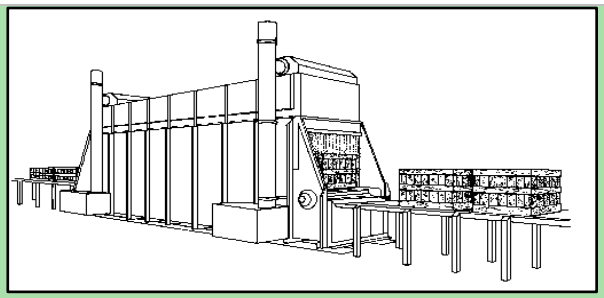


Figure 5: A Simple Hydro-Cooler

[33] Room cooling or still air-cooling is the least expensive method of cooling but it requires very long time, even up to several days. This method requires a minimum of handling and labor, but large spaces are also needed. Forced air-cooling is another rapid method of cooling. Forced-air (or vacuum cooling) cooling is accomplished by exposing the bulk boxes in a storage room to a higher air pressure on one



Source: https://content.ces.ncsu.edu/postharvest-cooling-and-handling-of-apples

side than the other. The unequal air pressure forces the cool air past the produce, greatly increasing the cooling rate. However, for this, it is essential that the apple containers have sufficient open space to allow for air movement. Therefore, depending on the fan capacity and the produce being cooled, forced-air cooling is 4-10 times faster than room cooling.

9. BENEFITS, COSTS, & FEASIBILITY ANALYSIS

9.1. Central Balochistan Cluster

9.1.1. Proposed Interventions

Summarizing Section 8, following intervention are suggested in the Central Balochistan clusters along with their expected benefits:

1. Renovation of old gardens with new high-density gardens on 15% of the total area with 100% increase in yield;
2. Improvement in management practices on the old gardens with 30% increase in yield
3. Improvement in harvesting technique with the reduction in harvest losses by 50%
4. Improvement in value chain by introducing pack-houses and collection centers to improve apple quality to fetch the imported apple price
5. Improve apple processing in cottage industry to convert 10% of apple into apple juices and apple puree.

After explaining the basic scenario without intervention, the following sections discus the economic and social feasibility of these interventions.

9.1.2. Baseline Status or Prevailing Situation

The baseline status of the apple production in Central Balochistan has been shown Table 12. At present, total apple orchard area in the focal point of Central Balochistan is about 1.471 thousand ha producing about 13.3 thousand tonnes of apple in 2015-16. The mean apple yield per ha falls at 9.05 tonnes with average annual growth as 4.9% per annum and farm gate price as US$ 529/tonne. Assuming that the current annual yield growth rate shall continue in coming five years from now, the present total value of output at farm gate price estimated as US$7.0 Million, shall increase to US$8.9 Million at 5th year of the project (Table 12).

Table 12: Yearly Baseline Status of the Sample Apple Cluster in Central Balochistan.

Items	Inputs	Year-1	Year-2	Year-3	Year-4	Year-5
Total apple area in the cluster (ha)	1,471					
Total apple production in the cluster (tonnes)	13,312					

Baseline yield (tonnes/ha)	9.05					
Annual yield growth in past 10 years (%)	**4.90%**					
Average farm gate price (US$/tonne)	529.00					
Apple yield growth w/o interventions (tonnes/ha)		9.05	9.94	10.42	10.93	11.47
Annual expected prod. w/o intervention (tonnes)		13,312	14,617	15,333	16,084	16,872
Total value of cluster output at farm gate price (Million US$)		7.042	7.732	8.111	8.508	8.925

9.1.3. Benefits of Proposed Interventions

Intervention-1: Orchards Renovation with High Density Plantation

There are many national and national level evidence showing many fold increase in yield with high-density orchards, but in this analysis, a modest increase in yield of 100% is assumed with high density orchard.

In renovating the old gardens, the old plants will be pruned to create space for new plants. The old and new plants will continue growing side by side, until the fourth year when the new plants will start fruiting. In this way, farmers will have to suffer a relative small loss during the gestation period of the new gardens. It is assumed that in coming 5 years, 15% of the total orchard area of the cluster shall be renovated with high-density apple plantation. In this way, 3742.50 ha of apple orchards shall be renovated in 5 years in the Central cluster. As the gestation period of apple is 3 years, the additional plants inserted shall start fruit in 4th year. Therefore, the apple production from the 1st year renovated orchard shall be double than the non-renovated ones. The total value of additional apple produced from renovated orchards at farm gate price shall be US$ 1.545 Million during the 8th year of the project (Table 13).

Table 13: Yearly Gross Revenue from Orchards Renovation with High Density Plantation in the Central Balochistan Cluster.

Items	Inputs	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8
Percent apple orchards renovated with high density	15%	-	-	-	-	-			

orchards in coming five years									
Percent area of orchards that would have been renovated every year		3.0%	6.0%	9.0%	12.0%	15.0%	-	-	
Orchard area that would be renovated (ha)		748.5	1,497.00	2,245.50	2,994.00	3,742.50			
Assumed yield increase from renovated orchards (%)	100%	-	-	-	-	-			
Additional production from increased yield (tonnes)		-	-	-	483	1,012	1,593	2,228	2,921
Expected additional value of produce at farm gate price (000 US$)		-	-	-	255.3	535.5	842.6	1178.6	1545.4

Intervention-2: Raising Productivity by Better Management Practices

For the second intervention pertaining to the adoption of better management practices, the farmers shall be educated through demonstrations and organizing farmers' days in the area. Based on the results of such experiments on farmers' fields. It is anticipated that the mean apple yield in the areas shall improve by 30% during 5 years of project period. Since, this interventional shall be operational on the entire cluster, therefore, its benefits are expected to be started realized by the farming community in 2nd year of the project period. In this way, the average improvement to the tune of about 2.15 tonnes/ha shall be realized in the 5th year of the project period. The additional production achieved from adoption of improved management practices in 5th year shall be 5.84 thousand tonnes resulting additional benefits to farming community shall be more than US$ 3.09 Million (Table 14).

Table 14: Yearly Gross Revenue from Better Orchard Management in Central Balochistan Cluster.

Items	Inputs	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8

Percent increase in yield over five years	30%	7.50%	15.00%	22.50%	30.00%	30.00%	30.00%	30.00%
Increase in yield after intervention (tonnes/ha)		0.75	1.56	2.46	3.44	3.61	3.79	3.97
Addition production achieved from enhanced yield (tonnes)		1096	2300	3619	5062	5310	5570	5843
Expect value of additional production at farm gate price (000 US$)		580	1,217	1,914	2,678	2,809	2,946	3,091

Intervention-3: Controlling Harvest and Post-Harvest Losses

This intervention is aimed at realizing apple growers that instead of paying harvesters on quantity of apple plucked the payment should be on right grade apples picked. Similarly, instead of packing the harvested apples in large boxes and stuffing both the better and lower grade apples at different layers, two-layer paper-box packaging method shall be introduced. Some of the measures introduced in the next section to improve apple value will also reduce post-harvest losses. It is assumed that by adopting these grading, packaging, and value chain measures, the post-harvest losses shall be halved from current 30% of the produce to 15% in 5 years' period. By this way, more than 34 thousand tonnes of additional marketable surplus shall be achieved in 5th year of the period, valued at US$1.821 Million (Table 15).

Table 15: Yearly Gross Revenue from Controlling Post-Harvest Losses in the Central Balochistan Cluster.

Items	Inputs	Year2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8
Current post-harvest losses (%)	30%	-	-	-	-	-	-	-
Expected reduction in post-harvest losses after interventions (%)	15%	3.75%	7.50%	11.25%	15.00%	15.00%	15.00%	15.00%
Addition production achieved due to reduced post-harvest losses (tonnes)		589	1,322	2,271	3,442	3,442	3,442	3,442
Expected value of additional production	**519**	**312**	**700**	**1201**	**1821**	**1821**	**1821**	**1821**

at farm gate price (000 US$)								

Intervention-4: Improvement in Value Chain to Enhance Quality

Under this intervention, the emphasis will be on improving apple quality by introducing post-harvest field-heat sinking, grading and standardization close to international standards, branding, better packaging, forked loading/unloading, refrigerated transport and marketing through newly established Departmental/Super stores, etc. For this purpose, value chain infrastructure like 170 pack-houses and 79 collection centers and will be established at various FEGs level, and the progressive apple farmers and traders will be trained for quality production and value chain management. Moreover, various ISO based quality certifications shall also be introduced, which shall be written on the pack along with harvesting/packaging and expiry dates, as well as other necessary instructions for keeping at home.

Successful implementation of the proposed strategies shall result in net gains to the farming community as well as other stakeholders in the value chain. Since, renovation of existing apple orchards with newly introduced high yield importing varieties has been suggested as first prime intervention, it is therefore, presumed that the additional production from these renovated orchards, plus the additional quality apple produced from following improved management practices and post-harvest control shall be converted into value added fresh apple forms. The high quality apples will mainly substitute the imported apple, and niche buyers like super stores are able to pay its import parity prices, estimated at US$877 per tonne, i.e. US$348 per tonne higher than average domestic wholesale price of non-value added apples. As a result, 1.685 thousand tonnes of quality apple shall be available from 2nd year of the project, and its quantity shall increase to 12.206 thousand tonnes by 5th project year. In value terms, the value chains stakeholders shall be benefitted to the extent of US$4.247 thousand during 2nd year of the project, which will further increase to US$3.312 Million by 5th project year (Table 16).

Table 16: Yearly Revenues from the Improvement in Apple Value Chain in the Central Balochistan Cluster.

Items	Inputs	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8
Total expected quantity to be transformed into international quality standards (tonnes)		-	1,685	3,622	6,372	9,516	10,345	11,240	12,206
International import price (US$ per tonnes)	877.0								

Total value of earnings from import-substituted apples (000 US$)	**501**	**-**	586.5	1,260.6	2,217.6	3,311.5	3,599.9	3,911.4	4,247.7

Intervention-5: Apple Juice Making as Cottage Industry

This intervention involves establishing juice making cottage industry at the union council. A unit with 50 juice making extraction machines will be incentivized in the private sector under FEGs. The government will provide 20% subsidy on the machine and interest free loans to the investors. Each unit will have two chillers of one-tonne capacity each. The juice extracted from each unit will be collected by packaging industries see (Annexure 6)**.** The farmers can also bring their produce for juice extraction to the juice extraction centers and can be charged for the services provided. The profit can be divided proportionate to the investment share of each stakeholder.

It is presumed that in 5-year project period, the 10% of total apple produced in the cluster shall be processed for juice making. This will require nearly 5 such units to be installed in the cluster at union council levels till 5th year of the project period. In this way, by 5th year, about 2639 tonnes of apple shall be processed for making more than 18 thousand tonnes of juice per season, and generating nearly US$22 Million of business to the farming community (Table 17). The detail feasibility of apple juice is given in annexure 6.

Table 17: Yearly Revenue from Apple Processing for Juice Making in the Central Balochistan Cluster.

Items	Inputs	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8
Current percentage of apple processed for juice making (%)	0.0%	-	-	-	-	-	-	-
Percent production processed over 5 years = % of fresh apple	10.0%	2.5%	5.0%	7.5%	10.0%	10.0%	10.0%	10.0%
Quantity of apple available for juice making purposes (tonnes)		408	948	1,684	2,639	2,639	2,639	2,639
Total quantity of apple juice produced (tonnes) at @ conversion rate of 1.4 tonnes fresh= 1 tonne juice	-	291	677	1,203	1,885	1,885	1,885	1,885

Expected value of apple juice produced (000 US$)	**1200**	349	812	1,444	2,262	2,262	2,262	2,262

9.1.4. Summary of Gross Revenue

Table-18 summaries the yearly gross revenue stream from the interventions introduced in the sample apple cluster of Central Balochistan. It clearly shows that the social benefits from the cluster shall begin from US$1.82 Million in 2nd project year to US$12.96 Million in 5th year (Table 18).

Table 18: Yearly Expected Gross Returns (US$) from Apple Cluster Development Interventions from Central Balochistan Cluster.

Interventions	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8
Orchards renovation	-	-	255.3	535.5	842.6	1178.6	1545.4
Improved orchard management	579.9	1,216.7	1,914.4	2,677.6	2,808.8	2,946.5	3,090.8
Controlling post-harvest losses	311.7	699.6	1201.3	1820.8	1820.8	1820.8	1820.8
Improving value chain to improve quality for import-substitution	586.5	1,260.6	2,217.6	3,311.5	3,599.9	3,911.4	4,247.7
Introducing apple juice making	349.3	812.4	1,443.6	2,261.8	2,261.8	2,261.8	2,261.8
Total (000 US$)	1,827.4	3,989.1	7,032.1	10,607.3	11,333.9	12,119.0	12,966.6

9.1.5. Costs Associated with Proposed Interventions

Intervention-1: Orchards Renovation with High Density Plantation

The high-density orchards plantation involves investment at two fronts. On farmers' side, it involves incurring expenses on planting the trees of improved varieties from certified nurseries in the large spaces available among the existing trees, plus caring these trees until they start fruiting. On service providers' side, it involves upgradation of available nurseries in producing certified plants of modern improved varieties. Therefore, first the available nurseries shall be registered before providing them mother plants of modern improved varieties. Meanwhile, they shall be provided bud-wood for grafting on the rootstock plants available with them. The yearly details about the costs of orchards renovation in the cluster revealed that this intervention shall cost US$0.314 Million in 1st project year, which shall increase to US$0.419 Million by 5th year (Table 19).

Table 19: Yearly Costs of Orchards Renovation with High Density Plantation in the Central Balochistan Cluster.

Items	Total	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8
Av. cost of orchard renovation. (US$)	6,918								
Yearly renovation rate (%)	15%	3%	3%	3%	3%	3%			
Total cost of orchard establishment (000 US$)[1]		305.3	305.3	305.3	305.3	305.3	0.0	0.0	0.0
Total acreage in gestation period (ha)		44.13	88.26	132.39	176.52	220.65	176.52	132.39	88.26
Av. management cost of orchard in gestation period (US$)	200								
Orchard management cost in gestation period (Million US$)		8826	17652	26478	35304	44130	35304	26478	17652
New acreage in fruiting (Ha)		-	-	-	44.13	88.26	132.39	176.52	220.65
Management cost of new orchard in fruiting (000 US$)	***793***	**-**	**-**	**-**	34.99	69.99	104.98	139.97	174.97
Total additional orchard renovation cost (000 US$)		314.1	322.9	331.8	375.6	419.4	140.3	166.5	192.6

[1] For details about orchard establishment costs, See Annexure-1.

Intervention-2: Raising Productivity by Better Management Practices

For exploiting the productivity potential of the apple orchards of the area, the farmers of the area shall be trained for adopting improved management practices, e.g. regular pruning of the orchards, applying recommended doses of fertilizers and the micronutrients, spraying the orchards on regular basis to protect from various insects and diseases, etc. Adoption of these management practices will increase farmer's costs from the farmers' perspective the yearly costs of adopting better orchard management practices is given in Table 20. It shows that the total cluster level additional costs of orchard management shall be US$0.67 Million in 1st project year, which shall increase to US$1.09 Million by 5th project year.

Table 20: Yearly Costs of Better Orchard Management in the Central Balochistan Cluster.

Items	Inputs	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8
Existing management cost (US$/ha)	376								
% increase in management cost from the current level of US$ 400/ha (US$)	111%	22%	22%	44%	66%	88%	110%	111%	111%
T. additional mgmt. cost of cluster (000 US$)[1]		675.7	798.4	921.1	1012.4	1096.5	1061.5	1026.5	991.5

[1] For details about management costs, See Annexure-2.

Intervention-3: Controlling Post-Harvest Losses

Controlling post-harvest losses involves new investments in harvesting, grading, packaging, transport and loading/unloading methods. This requires investments from the farmers as well as on the establishment of infrastructure and serve providing industries/sectors. Yearly distribution of costs borne by farmers/pre-harvest contractors is given in Table 21. It shows that the total cluster level additional costs of controlling post-harvest losses shall be US$1.627 Million in project 1st year, which shall increase to US$2.219 Million till 5th year.

Table 21: Yearly Costs of Controlling Post-Harvest Losses in Central Balochistan Cluster.

Items	Inputs	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8
Current cost of controlling post-harvest losses (US$/Ha)	75.71	-	-	-	-	-	-	-	-
Incremental costs of adopting new post-harvest practices (%)	50.0%	10%	10%	20%	30%	40%	50%	50%	50%
T. increase in cost of controlling post-harvest losses (000 US$)[1]		162.7	177.5	192.3	207.1	221.9	221.9	221.9	221.9

[1] For details about new post-harvest losses controlling costs, See Annexure-3.

Intervention-4: Apple Value Chain Development

Keeping in view the rising demand for quality apples in the domestic market, it has been decided to develop apple value chain infrastructure for making high quality apple available to our high-end consumers who mostly buy imported-apple from Super/Departmental Stores. Apart from the infrastructure investment cost to be discussed in the next section, this investment will increase operational costs by 87%. Yearly distribution of the operational cost of value chain improvement that have to be borne by farmers with domestic wholesaling and banding would require additional operational costs of US$0.204 Million from the 2nd project year, which shall increase to US$1.185 Million by 5th project year (Table 22).

Table 22: Year Costs of Apple Value Chains Development in the Central Balochistan Cluster.

Items	Overall	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8
Current value chains costs (US$/tonne)	50.0	-	-	-	-			
Improved value chains costs (US$/tonne)	93.0							
Percent increase in cost due to improved value chains	86.7%	86.7%	86.7	86.7	86.7			
T. increase in cost due to imp. Value chain (Mill. US$)		157.3	338.1	594.8	888.2	965.5	1049.1	1139.3
Additional cost of wholesaling in domestic market (Million US$)		30.4	69.3	128.6	202.2	219.8	238.8	259.4
Cost of branding (Mill. US$)		16.9	36.2	63.7	95.2	103.4	112.4	122.1
Total cost (000 US$)		205	444	787	1186	1289	1400	1521

[1] For details about new post-harvest losses controlling costs, See Annexure-4.

Intervention-5: Apple Juice Making as Cottage Industry

As already mentioned that household level juice making units shall be consisted of a cluster of 50 households, each having one juicer machine operated by the household female. The estimated average juice making cost is US$241.53/tonne. In this way, it will generate employment opportunity for the poor village women. A juice collector/assembler shall collect the concentrated juice on daily basis and pack it after adding necessary preservatives and market it. The necessary training shall be provided to these women. It is worth mentioning here, that juicy and relatively small sized apples, which do not suit to put in prime grades, will be used for juice making. The yearly distribution of juice making and raw material cost (i.e. the apple used for juice making) is given in Table 23. It shows that the cluster level additional costs of concentrated apple juice

making shall be US$2.49 Million in 2nd project year, which shall increase to US$16.145 Million by 5th project year.

Table 23: Yearly Costs of Apple Processing for Juice Making in the Central Balochistan Cluster.

Items	Inputs	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8
Juice making cost per tonne (US$)	241.53	-	-	-	-	-			
% increase in juice making & packaging cost	0.00%	-	0.00	0.00	0.00	0.00			
T. increase cost in juice making/ packing (000 US$)	-	-	98.4	228.9	406.8	637.4	637.4	637.4	637.4
Total raw material cost in processing (000 US$)[1]	-	-	150.9	351.0	623.7	977.2	977.2	977.2	977.2
Total cost of juice making (000 US$)			**249.4**	**579.9**	**1030.5**	**1614.5**	**1614.5**	**1614.5**	**1614.5**

[1] For details about new post-harvest losses controlling costs, See Annexure-4.

9.1.6. Summary of the Costs

Table-24 summaries the yearly costs stream associated to various interventions introduced in the sample apple cluster of Central Balochistan. It clearly shows that the cluster level societal costs shall begin from thousand US$11.525 in 1st project year to US$4541 thousand in 8th project year.

Table 24: Expected Costs of Cluster Development Interventions in Central Balochistan.

Items	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8
Intervention-1: Orchards renovation and young garden management (000 US$)	314.1	322.9	331.8	375.6	419.4	140.3	166.5	192.6
Intervention-2: Improved orchard management (000 US$)	675.7	798.4	921.1	1,012.4	1,096.5	1,061.5	1,026.5	991.5
Intervention-3: Controlling post-harvest losses (000 US$)	162.7	177.5	192.3	207.1	221.9	221.9	221.9	221.9
Intervention-4: Improved value chain	-	157.3	338.1	594.8	888.2	965.5	1049.0	1139.2

for import-substitution (000 US$)								
Intervention-5: Introducing apple juice making (000 US$)	-	249.4	579.9	1030.5	1614.5	1614.5	1614.5	1614.5
Total (000 US$)	1152.5	1752.8	2468.6	3412.7	4537.8	4326.9	4429.6	4541.2

9.1.7. Stream of Benefits

Table 25 pertains to the yearly stream of net-economic benefits after offsetting the direct value chains costs incurred for the development apple cluster in Central Balochistan. It clearly shows that the stream of net-economic benefits shall begin from US$0.25 Million (as net-costs, mainly attributed to expenses and management of new plantations) in 1st project year, which will transform into net-benefits amounting US$-1.52 Million in 3rd project year and further to US$6.07 Million in 5th project year. This clearly implies a strong economic viability of investing into development of apple cluster in central Balochistan.

Table 25: Net-Economic Benefits after Offsetting the Direct Value Chains Costs in Central Balochistan.

Items	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8
Total expected gross returns from cluster development interventions (000 US$)	-	1827	3989	7032	10607	11334	12119	12967
Gross costs to be incurred on cluster development interventions (000 US$)	1152.5	1752.8	2468.6	3412.7	4537.8	4326.9	4429.6	4541.2
Net-economic benefit (000 US$)	247.1	-1152.5	74.7	1520.6	3619.4	6069.5	7007.1	7689.5

9.1.8. Investments for Cluster Development

For improving the apple cluster in Central Balochistan, investments need to be incurred in a number of areas. The areas where investment would be required, and needed yearly investment flow in each area are listed in Table 26. The detail of these investment calculations can be seen in the EXL Model sheet attached with the report.

Table 26: Public Investment Needed for Central Balochistan Apple Cluster Development.

Items	Total	Year-1	Year-2	Year-3	Year-4	Year-5
Improving research infrastructure & operations (US$)	500,000	200,000	150,000	75,000	75,000	
Capacity building & Farmers Enterprise Groups for improved management practices (US$)	54,481	21,793	16,344	8,172	5,448	2,724
Investments required for orchard renovation (US$)	1,221,100	305,275	305,275	305,275	305,275	
Certified nursery establishment(US$)	27,610	27,610	-	-	-	
Establishing collection centers and organizing FEGs (US$)	74,074	29,630	22,222	11,111	11,111	
Establishing pack houses (US$)	1,281,440	160,180	320,360	320,360	480,540	-
Processing/juice making interventions (US$)	240,970	48,194	48,194	48,194	96,388	-
Government loans on private investments (US$)	167,465	22,921	40,541	40,541	63,462	-
Total investment on the cluster needed (US$)	**3,567,141**	**815,602**	**902,937**	**808,653**	**1,037,224**	**2,724**

It shows that total investment needed of US$3.56 million shall be required for the improvement of apple cluster in Central Balochistan.

9.1.9. Economic Viability

Table 27 presents the overall net-benefits after deducting investments from net-economic returns. The net-present value of this stream of net-benefits was calculated at the discount rate of 8.50%, which came to be US$17.0 million. The Internal Rate of Returns (IRR) to the investments and costs incurred came to be 71 percent --- clearly indicating that it is an economically viable project. It can, therefore, be concluded that it is clearly worth investing into the cluster for the uplift of the apple production in the area through various proposed farm, domestic marketing level investments.

Table 27: NPV and IRR of Central Balochistan Apple Cluster Development Plan

Items		Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8

Net-cash flow (Mil. US$)		-1.968	-0.828	0.712	2.582	6.067	7.007	7.689	8.425
Discount rate (%)	8.50%								
Net-present value of the net-benefits (Mil. US$)	16.963								
Internal Rate of Returns (%)	**71.0%**								

9.2. Northern Balochistan Cluster

9.2.1. Proposed Interventions

Summarizing Section 8, following intervention are suggested in the Northern Balochistan Clusters along with their expected benefits:

1. Renovation of old gardens with new high-density gardens on 15% of the total area with 100% increase in yield in the renovated gardens after the gestation period;
2. Improvement in management practices on the old gardens with 15% increase in yield
3. Improvement in harvesting and packaging techniques with the reduction in harvest losses by from 30% to 15%.
4. Improvement in value chain by introducing pack-houses and collection centers to improve apple quality to fetch the imported apple price
5. Improve apple processing in cottage industry to convert 5% of apple into apple juices and apple puree.

It is worth noting that improved management practices were assumed to have less impact on yield in the Northern Cluster as compared to in Central Cluster because of already slow growth in yield in the former case. Moreover, the possibility of processing is also lower in the Northern Cluster because of the relatively easy access to the fresh apple market of Central Punjab.

After explaining the basic scenario without intervention, the following sections discus the economic and social feasibility of these interventions.

i. Baseline Status or Prevailing Situation

Table 28 shows the baseline status of the apple production in Killa Saifullah. At present, total area under apple orchards in Killa Saifullah is about 24.950 thousand ha produced nearly 262 thousand tonnes of apple in 2015-16. The mean apple yield per ha falls at 10.50 tonnes with average annual growth as 4.55% per annum and farm gate price as US$529/tonne. Assuming that the current

annual yield growth rate shall continue in coming five years from now, the present total value of output at farm gate price estimated as US$138.585 Million shall increase to US$160.170 Million at 5th year.

Table 28: Yearly Baseline Status of the Sample Apple Cluster in Killa Saifullah Apple Cluster.

Items	Inputs	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8
Total apple areas in the cluster (ha)	24,950								
Total apple production in the cluster (tonnes)	261,975								
Baseline yield (tonnes/ha)	10.500								
Annual yield growth in past 10 years (%)	4.55%								
Average farm gate price (US$/tonne)	529.00								
Average gross value of output (US$/ha)	5555.00								
Apple yield growth w/o interventions (tonnes/ha)		10.50	10.88	11.08	11.29	11.49	11.70	11.92	12.14
Annual expected prod. w/o intervention (tonnes)		261,975	271,563	276,533	281,593	286,747	291,994	297,338	302,779
T. value of cluster output at farm gate (Million 000 US$)		138585	143657	146286	148963	151689	154465	157292	160170

ii. Interventions and their Benefits

Intervention-1: Orchards Renovation with High Density Plantation

The first intervention proposed is increasing apple productivity through renovating the current orchard with high-density plantation in the cluster. It is assumed that in coming 5 years, 15% of the total orchard area of the cluster shall be renovated with high density apple plantation and the mean apple yield from these high density orchards shall increase by 100% --- attributed to more number of plants per ha. In this way, 2994 ha of apple orchards shall be renovated in 5 years. As the gestation period of apple is 3 years, the additional plants inserted shall start fruit in 4th year. Therefore, the apple production from the 1st year renovated orchard shall be double than their sister non-renovated orchards. The total value of additional apple produced from renovated orchards at farm gate price shall be US$ 4.469 Million and US$9.10 Million in 4th and 5th year of the project, respectively (Table 29).

Table 29: Yearly Gross Revenue from Orchards Renovation with High Density Plantation in Killa Saifullah Apple Cluster.

Items	Inputs	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8
% orchards area renovated with high density orchards in coming five years	15%	-	-	-	-	-			
% area of orchards renovated		3%	*3%*	*6%*	*9%*	*12%*	*15%*	3%	*3%*
Orchard area that would be renovated (ha)		748.50	748.50	1,497.0	2,245.5	2,994.0	3,742.5	748.5	748.5
Assumed yield increase from renovated orchards (%)	100%	-	-	-	-	-			
Additional production from increased yield (tonnes)		-	-	-	8,448	17,205	26,279	35,681	45,417
Expected additional value of produce at		**-**	**-**	**-**	4469	9101	13902	18875	24026

farm gate price (000 US$)									

Intervention-2: Raising Productivity by Better Management Practices

For the second intervention pertaining to the adoption of better management practices, the farmers will be educated through demonstrations and organizing farmers' days in the area. Based on the results of such demonstration on farmers' fields, it is anticipated that the mean apple yield in the areas shall improve by 15% during 5 years of project period. Since, this interventional shall be operational on the entire cluster, therefore, its benefits are expected to be started realized by the farming community in 2nd year of the project period. In this way, the average improvement to the tune of about 1.96 tonnes/ha shall be realized in the 5th year of the project period. The additional production achieved from adoption of improved management practices in 5th year shall be 45.4 thousand tonnes resulting additional benefits to farming community shall be nearly US$ 24.026 Million (Table 30).

Table 30: Yearly Gross Revenue from Better Orchard Management in Killa Saifullah Apple Cluster.

Items	Inputs	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8
Percent increase in yield over five years	15%	-	3.75%	7.50%	11.25%	15.00%	15.00%	15.00%	3.75%
Increase in yield after intervention (tonnes/ha)		-	0.41	0.83	1.27	1.72	1.76	1.79	1.82
Addition production achieved from enhanced yield (tonnes)		-	10184	20740	31679	43012	43799	44601	45417
Expect value of additional production at farm gate price (Million US$)	**529**	**-**	5387	10971	16758	22753	23170	23594	24026

Intervention-3: Controlling Post-Harvest Losses

This prime aim of this intervention is making to realize the apple growers that instead of paying on quantity of apple picked, the apple harvesting labor shall be paid on the basis different apple grades the plucked. Hence, their harvesting charges shall be adjusted in a way that their daily earnings should not affect. Similarly, instead of packing the harvested apples in large boxes and stuffing both the better and lower grade apples at different layers, two-layer paper-box packaging method shall be introduced. It is assumed that by adopting these grading and packaging measures, the post-harvest losses shall be halved from current 30% of the produce to 15% in 5 years' period. By this way, more than 55 thousand tonnes of additional marketable surplus shall be achieved in 5th year of the period, valued at US$ 27.532 Million (Table 31).

Table 31: Yearly Gross Revenue from Controlling Post-Harvest Losses in Killa Saifullah Cluster.

Items	Inputs	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8
Current post-harvest losses (%)	30%	-	-	-	-	-			
Expected reduction in post-harvest losses after interventions (%)	15%	-	4%	8%	11%	15%	15%	15%	15%
Additional production achieved due to reduced post-harvest losses (tonnes)		-	10,566	22,295	36,194	52,045	52,045	52,045	52,045
Expected value of additional production at farm gate price (000 US$)	**529**	-	5589	11794	19146	27532	27532	27532	27532

Intervention-4: Apple Value Chains Development for Import Substitution

Under this intervention, besides enhancing apple production, its quality shall also be enhanced by adopting post-harvest fruit handling practices like field heat sinking, grading and standardization close to international standards, introduction of brands, better packaging, forked loading/unloading, and refrigerated transport and marketing through newly established super stores in urban centers. For this purpose, the progressive farmers and apple traders shall be encouraged to participate in production and marketing of quality apple in the country. Moreover, various ISO based quality certifications shall also be introduced, which shall be written on the pack along with harvesting/packaging and expiry dates, as well as other necessary instructions for keeping at home. Successful implementation of these proposed strategies shall result in net

gains to the farming community as well as other stakeholders in the value chain. Since, renovation of existing apple orchards with newly introduced high yield importing varieties has been suggested as first prime intervention, it is therefore, presumed that the additional production from these renovated orchards, plus good quality apple from old orchards shall be converted into value added fresh apple forms. It is also presumed that niche customers of Super Stores are able to pay its import parity prices, which is estimated at US$ 877 per tonne, i.e. US$348 per tonne higher than average domestic wholesale price of non-value added apples. As a result, 20.794 thousand tonnes of quality apple shall be available from 2nd year of the project, and its quantity shall increase to 112.261 thousand tonnes by 5th project year. In value terms, the value chains stakeholders shall be benefitted to the extent of US$7.221 Million during 2nd year of the project, which will further increase to US$39.067 Million by 5th project year (Table 32).

Table 32: Yearly Revenues from Supplies of Import-Substituted Apples from Killa Saifullah Cluster.

Items	Inputs	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8
Total expected quantity to be transformed into international quality standards (tonnes)		-	20,749	43,035	76,321	112,261	122,123	132,326	142,878
International import price (US$ per tonne)	877.0								
Total value of earnings from import-substituted apples (000 US$)	**501**	-	7221	14976	26560	39067	42499	46049	49722

1. Intervention-5: Apple Juice Making as Cottage Industry

This intervention involves establishing juice making cottage industry at the union council levels and collecting this juice by some packaging industry from these small units. It is presumed that in 5-year project period, the 5% of total apple produced in the cluster shall be processed for juice making. This will require nearly 33 such units to be installed in the cluster at union council levels till 5th year of the project period. In this way, by 5th year, about 19.950 thousand tonnes of apple shall be processed for making more than 14 thousand tonnes of concentrated apple juice per season, and nearly US$17.10 Million business shall be created to the farming community (Table 33). The detail feasibility of apple juice is given in annexure 6.

Table 33: Yearly Revenue from Apple Processing for Juice Making in Killa Saifullah Cluster.

Items	Inputs	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8
Current percentage of apple processed for juice making (%)	0.0%	-	-	-	-	-			
Percent production processed over 5 years = % of fresh apple	5.0%	-	1%	3%	4%	5%	5%	5%	5%
Quantity of apple available for juice making purposes (tonnes)		-	3,654	7,989	13,422	19,950	19,950	19,950	19,950
Total quantity of apple juice produced (tonnes) at @ conversion rate of 1.4 tonnes fresh= 1 tonne juice		-	2,610	5,707	9,587	14,250	14,250	14,250	14,250
Expected value of apple juice produced (000 US$)	**1200**	**-**	3132	6848	11504	17100	17100	17100	17100

iii. Summary of Gross Revenue

Table 34 summaries the yearly benefits stream from the interventions introduced in the sample apple cluster of Klla Saifullah, Balochistan. It clearly shows that the social benefits from the cluster shall begin from US$21.329 Million in 2nd project year to US$142.404 Million in last year. This clearly implies an increase of more than 5 times during the project period – signifying considerable attraction for investment in the apple cluster development related interventions.

Table 34: Yearly Expected Gross Returns from Apple Cluster Development Interventions from Killa Saifullah Apple Cluster.

Interventions	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8
Orchards renovation	-	-	4469	9101	13902	18875	24026
Improved orchard management	5387	10971	16758	22753	23170	23594	24026
Controlling post-harvest losses	5589	11794	19146	27532	27532	27532	27532
Improving fresh apples quality as import-substitution for selling in domestic market	7221	14976	26560	39067	42499	46049	49722

Introducing apple juice making	3132	6848	11504	17100	17100	17100	17100
Total	21329	44590	78438	115553	124202	133150	142404

iv. Costs Associated with Proposed Interventions

Orchards Renovation with High Density Plantation

The high-density orchards plantation involves investment at two fronts, i.e. expenses on plantation of trees of improved varieties from certified nurseries and upgradation of nurseries of the area for provision of such plants to the farmers in the long-run. Hence, the nurseries will be registered first and then the mother plants of modern improved varieties will be provided to them for further propagation. The yearly details about the costs of orchards renovation in the cluster revealed that this intervention shall cost US$5.328 Million in 1st project year, which shall increase to 7.113 Million by 5th year (Table 35).

Table 35: Yearly Orchards Renovation Costs with High Density Plantation in Killa Saifullah Cluster.

Items	Inputs	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8
Av. cost of renovating HD orchard (US$)	6,918								
Assumed yearly increase in cost (%)	15%	3%	3%	3%	3%	3%			
Total cost of orchard establishment (Million US$)[1]		***5.178***	***5.178***	***5.178***	***5.178***	***5.178***			
Total acreage in gestation period (ha)		748.50	1497.00	2245.50	2994.00	3742.50	2,994.00	2,245.50	1,497.00
Av. management cost of orchard in gestation period (US$)	200								

Orchard management cost in gestation period (000 US$)		149.7	299.4	449.1	598.8	748.5	598.8	449.1	299.4
New acreage in fruiting (Ha)		-	-	-	749	1,497	2,246	2,994	3,743
Management cost of new orchard in fruiting (000. US$)	***792.96***	**-**	**-**	**-**	593.5	1187.1	1780.6	2374.1	2967.7
Total additional orchard renovation cost Mil.US$)		5.63	6.08	6.53	7.57	8.61	3.58	3.72	3.87

[1] For details about orchard establishment costs, See Annexure-1.

Intervention-2: Raising Productivity by Better Management Practices

For achieving the productivity potential of the apple orchards of the area, the farmers of the area shall be trained for adopting improved management practices, e.g. regular pruning of the orchards, applying recommended doses of fertilizers and the micronutrients, spraying the orchards on regular basis to protect from various insects and diseases, etc. This involves investment from the farmers as well as expenditures from the research/extension/advisory services related institutions. From the farmers' perspective, the yearly costs of adopting better orchard management practices. It shows that the total cluster level additional costs of orchard management shall be US$11.460 Million in 1st project year, which shall increase to US$18.597 Million by 5th project year (Table 36).

Table 36 Yearly Costs of Better Orchard Management in Killa Saifullah Apple Cluster.

Items	Inputs	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8
Existing management cost (US$/ha)	376								
% increase in management cost from the current level of US$ 400/ha	110.94%	22%	44%	67%	89%	111%	111%	111%	111%
T. additional mgmt. cost of cluster (000 US$)[1]		11460	13541	15622	17172	18597	18004	17410	16817

[1] For details about management costs, See Annexure-2.

Intervention-3: Controlling Post-Harvest Losses in Killa Saifullah

Controlling post-harvest losses involves new investments in harvesting, grading, packaging, transport and loading/unloading methods. This requires investments from the farmers as well as on the establishment of infrastructure and serve providing industries/sectors. Yearly distribution of costs borne by farmers/pre-harvest contractors is given in Table 38. It shows that the total cluster level additional costs of controlling post-harvest losses shall be US$3.202 Million in 1st project year, which shall increase to US$4.366 Million till 8th year (Table 37).

Table 37: Yearly Costs of Controlling Post-Harvest Losses in Killa Saifullah Apple Cluster.

Items	Inputs	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8
Current cost of controlling post-harvest losses (US$/Ha)	116.67	-	-	-	-	-			
Incremental costs of adopting new post-harvest management practices for controlling losses (%)	50.0%	10%	20%	30%	40%	50%	50%	50%	50%
T. increase in cost of controlling post-harvest losses (000 US$)[1]		3202	3493	3784	4075	4366	4366	4366	4366

[1] For details about new post-harvest losses controlling costs, See Annexure-3.

Intervention-4: Apple Juice Making as Cottage Industry in Killa Saifullah

As already mentioned that household level juice making units shall be consisted of 50 households, each having one juicer machine each operated by women. The average juice making cost is estimated at US$221/tonne. In this way, it will generate employment opportunity for the poor rural women, who will work indoor in their villages. A juice collector/assembler shall collect the concentrated juice on daily basis and pack it after adding necessary preservatives and market it. The necessary training shall be provided to these working women. It is worth mentioning here, that juicy and relatively small sized apples, which do not suit to put in prime grades, shall be used for juice making. The yearly distribution of juice making and raw material cost (i.e. the apple used for juice making) is given in Table 39 below. It shows that the cluster level additional costs of concentrated apple juice making shall be US$2.815 Million in 2nd project year, which shall increase to US$15.372 Million by 5th project year (Table 38).

Table 38: Yearly Costs of Apple Processing for Juice Making in Killa Saifullah Apple Cluster.

Items	Inputs	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8
Juice making cost per tonne (US$)	241.53	-	-	-	-	-			
% increase in juice making & packaging cost	0.00%	-	0.00	0.00	0.00	0.00			
T. increase cost in juice making/packing (000 US$)	-	-	883	1930	3242	4819	4819	4819	4819
Total raw material cost in processing (Mill. US$)[1]	-	-	1,933	4,226	7,100	10,554	10,554	10,554	10,554
Total cost of juice making (Million US$)			2,815	6,156	10,342	15,372	15,372	15,372	15,372

For details about new post-harvest losses controlling costs, See Annexure-4.

Intervention-5: Apple Value Chain Development for Import Substitution

Keeping in view the rising demand of apple for domestic market, it has been decided to develop international standard apple value chains for making high quality apple available our consumers --- mostly buy imported-apple from Super/ Departmental Stores. Yearly distribution of cost attribution to apple import-substitution with domestic wholesaling and banding shows that the total cluster level additional costs shall begin from US$2.651 Million in 2nd project year, which shall increase to US$15.930 Million by 5th project year (Table 39).

Table 39: Year Costs of Apple Value Chains Development for Import Substitution in Killa Saifullah Cluster.

Items	Inputs	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8
Current value chains costs (US$/tonne)	50.00	-	-	-	-	-	-	-	-
Improved value chains costs (US$/tonne)	93.00								
Percent increase in cost due to improved value chains	86.68%	-		87%	87%	87%	87%	87%	87%
Total increase in cost due to imp. Value chain (000 US$)		-	1,937	4,017	7,124	10,478	11,399	12,351	13,336

Additional cost of wholesaling in local market (000 US$)			*375*	*823*	*1,541*	*2,386*	*2,595*	*2,812*	*3,036*
Cost of branding (000 US$)			207	430	763	1123	1221	1323	1429
Total cost (000 US$)			**19990**	**27846**	**36460**	**47387**	**59436**	**55337**	**56458**

1 For details about new post-harvest losses controlling costs, See Annexure-4.

v. Summary of the Costs

Table 40 summarize the yearly costs stream associated to various interventions introduced in the sample apple cluster of Killa Saifullah. It clearly shows that the cluster level societal costs shall begin from US$19.990 Million in 1st project year to US$53.158 Million in 8th project year.

Table 40: Expected Costs of Cluster Development Interventions in Killa Saifullah.

Items	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8
Intervention-1: Orchards renovation (000 US$)	5327.5	5477.2	5626.9	6370.2	7113.4	2379.4	2823.2	3267.1
Intervention-2: Improved orchard management (000 US$)	11460	13541	15622	17172	18597	18004	17410	16817
Intervention-3: Controlling post-harvest losses (000 US$)	3202	3493	3784	4075	4366	4366	4366	4366
Intervention-4: Introducing apple juice making (000 US$)		2,815	6,156	10,342	15,372	15,372	15,372	15,372
Intervention-5: Improved value chain for import-substitution (000 US$)		1,937	4,017	7,124	10,478	11,399	12,351	13,336
Total cost (000 US$)	**19990**	**27263**	**35206**	**45083**	**55926**	**51520**	**52322**	**53158**

Table 41 pertains to the yearly stream of net-economic benefits after offsetting the direct value chains costs incurred for the development apple cluster in Killa Saifullah. It clearly shows that the stream of net-economic benefits shall begin from US$-19.990 Million (as net-costs, mainly attributed to expenses and management of new plantations) in 1st project year, which will transform into net-benefits amounting US$ Million in 3rd project year and further to US$56.118 Million in 5th project year.

Table 41: Net-Economic Benefits after Offsetting the Direct Value Chains Costs in Killa Saifullah.

Items	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8
Total expected gross returns from cluster development interventions (000 US$)	-	21329	44590	78438	115553	124202	133150	142404
Gross costs to be incurred on cluster development interventions (000 US$)	19990	27846	36460	47387	59436	55337	56458	57623
Net-economic benefit (US$)	-19990	-6517	8130	31050	56118	68865	76692	84781

vi. Investments Needs

For improving the target apple cluster, investments need to be incurred in a number of areas, like:

i) Improving research infrastructure and operation though a continued investment is needed for the development of apple related research infrastructure, but for the start-up, under five years' project approach the Apple Research and Development Center will be established at Agriculture Research Institute, Sariab, Quetta.

ii) Farmers' capacity building will be done and Farmers' Enterprise Groups (FEGs) will be established.

iii) Investment in renovating existing orchards will be needed, which will be carried out with the assistance of financial institutions;

iv) For the establishment of certified apple nurseries, which will initially get plant material (bud-wood and certified rootstock) from the above described center;

v) Establishment of fruit/products collection centers through Farmers' Enterprise Groups;

vi) Establishment of pack-houses at appropriate locations in the clusters, so that good quality apple is properly packed before siphoning off to various destinations in the country;

vii) Development of cottage-level apple processing units in the cluster; and,

viii) Some money shall be allocated as short-term Government loans to facilitate establishing value chain infrastructure.

As all the above calculations are made on the basis of a 5-year project, therefore, the year stream on investments required for all the eight proposed areas is given in Table 42 below. It shows that a total project based investment of US$43.0 Million shall be required for the improvement of Killa Saifullah apple cluster.

Table 42: Public Investment Needed for Apple Cluster Development in Killa Saifullah.

Items	Inputs	Year-1	Year-2	Year-3	Year-4	Year-5
Improving research infrastructure & operations (US$)	500,000	200,000	150,000	75,000	75,000	75,000
Capacity building & Farmers Enterprise Groups for improved management practices (US$)	924,074	369,630	277,222	138,611	92,407	46,204
Investments required for orchard renovation (US$)	20,711,383	5,177,846	5,177,846	5,177,846	5,177,846	-
Invest. required for certified nursery establishment (US$)	468,292	468,292	-	-	-	-
Investment required for establishing collection centers and organizing FEGs (US$)	1,851,852	740,741	555,556	277,778	277,778	-
Investments required for establishing pack houses (US$)	15,056,920	2,723,060	3,043,420	4,485,040	4,805,400	-
Investments required on processing/juice making interventions (US$)	1,590,404	289,164	337,359	433,747	530,135	-
Government loans on private investments (US$)	1,831,206	331,345	371,886	541,067	586,909	-
Total investment on the cluster needed (US$)	43,009,131	10,300,077	9,913,288	11,129,088	11,545,475	121,204

vii. Economic Viability of Apple Cluster Development Plan

Table 43 presents the overall net-benefits after further deducting investments from net-economic returns. The net-present value of this stream of net-benefits were estimated at the discount rate of 8.50%, which came to be US$137.8 Million. The Internal Rate of Returns (IRR) to the investments and costs incurred came to be 46.0% clearly indicating that it is an economically viable project. It can, therefore, concluded that it is clearly worth investing into the cluster for the uplift of the apple production in the area through various proposed farm, domestic marketing level investments.

Table 43: Net-Present Value and Internal Rate of Returns of Costs and Investments Incurred for the Development of Apple Cluster in Killa Saifullah.

Items	Total	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8
Overall net-cash flow mil. US$)		-30.2899	-16.4304	-2.9987	19.5050	55.9965	68.8653	76.6916	84.7811
Discount rate (%)	8.50%								
NPV (Mil. US$)	137.8								
Internal Rate of Returns (%)	46.0%								

10. SUMMARY AND CONCLUSIONS

The financial and other impacts of various development interventions proposed in the form of 5-years long development projects to be implemented at the focal points of apple clusters in central and northern Balochistan. The proposed interventions include renovating the existing area with high density-plantation (by halving the inter-tree and inter-row distances) with trees of more productive and imported or native modern varieties; promotion of improved management practices and controlling post-harvest losses. As a result, the renovated orchards in the focal points of the two clusters shall increase total production by 155.1 thousand tonnes during the 5th year after project inception and provide gross revenue to the farming community to the tune of US$155.4 Million. Introduction of processing of concentrated fresh apple juice from low-grade apple through the development of cottage industry with due collecting, packaging and transport arrangements shall result financial benefits amounting US$19.4 Million. This will also generate employment to rural women in the cottage industry. The efforts aimed at improving the quality of apple equivalent to international standards through value addition with due quality certifications, branding shall result gross benefit amounting US$54.0 Million to the society. This makes total net-cash flow after discounting all direct and indirect costs amounting US$93.2 Million. These interventions will save the foreign exchange spent on the import of apple by 29%. To achieve these benefits, following strategies will be adopted:

- Establish an Apple Research and Development Institute in Balochistan at its provincial Agricultural Research Institute at Sariab Quetta, while one sub-station should be established within each of the cluster.
- Mobilize the provincial department of agricultural extension for convincing farmers about renovating existing apple orchards by creating spaces in the existing gardens through pruning and planting high-yielding improved varieties in the space for early adoption of improved orchard management practices.
- Mobilize the farmers to develop FEGs at the Union Council level who can mobilize resources to solve the cluster problems at local level, manage the Collection Centers, and ensure quality to the traders and link all incentives through FEGs on cost-sharing basis.
- Incentivize the establishment of Collection Center for several union councils depending upon the production level of different union councils, which has the basic facility for apple collection, grading, packaging, and processing.
- Training of farmers and other stakeholders along the value chain on the adoption of improved value chain management practices through foreign and local experts as well as sending key stakeholders abroad for foreign training on value chain management.

It is concluded that the development impact of the two clusters shall be sustainable and long-lasting. The estimated Internal Rate of Return (IRR) for each Cluster and overall suggest economic viability of investing into these clusters. The given recommendations are based on

practical experience in the horticulture subject, visits to the core areas of clusters and interviews with apple growers and stakeholders.

11. Annexures

Annexure-1: References and data sources

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Annexure-2: List of Farmers, Traders & Researchers Consulted

List of Farmers

S. No.	Farmer Name	Dated	Commodity	Contact No.	City/Area
1	Zain-ul-Abideen	18-8-2018	Apples	0313 9654351	Swat
2	Mohammad Afzal	8-11-2018	Apples	0345 7498366	Skardu
3	Raza	8-11-2018	Apples	0346 8483505	Skardu
4	Mustafa Ali	8-11-2018	Apples	0345 0881149	Skardu
5	Mohammad Hassan	8-11-2018	Apples	0344 5930787	Skardu
6	Qutub-ul-Din Raisani	11-8-2018	Apples	0336 0206971	Ziarat
7	Haji Abdul Hameed	29-9-2018	Apples	0333 2976466	Kalat
8	Mohammad Younus Mughal	29-9-2018	Apples	0333 2899778	Kalat
9	Rais Manzoor	29-9-2018	Apples	0333 6888086	Kalat
10	Mr. Kazim Khan	1-9-2018	Apples	0321 8001441	Killa Abdullah
11	Mr. Mr. Hashim Khan	1-9-2018	Apples	0300 3820011	Killa Abdullah

List of Traders & Dealers

S. No.	Name	Dated	Trader/Dealer	Commodity	Contact No.	City/Area
1	Mr. Waheed Ahmad	5-10-2018	Vice President of Fruit & Vegetables Exporters	Fruits & Vegetables	0321 8272772	Karachi
4	Mr. Jan Mohammad	11-8-2018	Trader	Apples	0334 2441583	Ziarat
5	Mr. Omesh Kumar	29-9-2018	Fertilizer & Pesticides	Apples	0333 7214152	Kalat
6	Mr. Sheikh Mohammad Naseem	29-9-2018	Fertilizer & Pesticides	Apples	0331 8075142	Kalat

List of Researchers & Administrators

S. No.	Name of Researcher	Dated	Research Institute/Center	Contact No.	Commodity	City/Area
1	Mr. Akhtar Gul	11-8-2018	Directorate of Agriculture Research at Ziarat	0300 3875039	Apples	Ziarat
2	Mr. Khalid Iqbal	11-8-2018	Directorate of Agriculture Research at Ziarat	0300 0454587	Apples	Ziarat
3	Mr. Mohammad Nawaz	11-8-2018	Directorate of Agriculture Research at Ziarat	0332 7925110	Apples	Ziarat
4	Mr. Amir Mohammad	11-8-2018	Directorate of Agriculture Research at Ziarat	0332 8093884	Apples	Ziarat
5	Mr Javed Rehaman	18-8-2018	Department of Agriculture Research	0346 9891172	Apples & Plums	Swat
21	Mr Javed Rehaman	18-8-2018	Department of Agriculture Research	0346 9891172	Apples & Plums	Swat

Annexure-3: Itemized distribution of high density apple orchard establishment costs

	Cost items	Improved Management practice	Current management practice
1.	Row × Row distance (feet)	10.00	20.00
2.	Tree × Tree distance (feet)	10.00	20.00
3.	Area of acre (square feet)	43560.00	43560.00
4.	Total number of plants per acre (#)	436.00	100 – 110
5.	Total number of plants per ha (#)	1076.00	245 – 275
6.	Total number of plants/ha in round figures (#)	1100.00	250-280
7.	Mortality allowance (%)	4.00%	4.00%
8.	Total number of plants per ha (#)	1144.00	-
9.	Price per 1000 plants @ US$ 2/plant	2000.00	-
10.	Plants cost per ha (US$)	2288.00	-
11.	Labor cost (US$/ha)	300.00	-
12.	Installing trellises @ Rs.150000/ac	2778.00	-
13.	Installing drip irrigation system (US$)	1852.00	-
14.	Total orchard renovation cost (US$/ha)	6918.00	-
15.	Average cost during gestation period (UD$/ha)	200.00	

Annexure-4: Characteristics and Comparison of Clusters

Salient Features	Northern Cluster (Balochistan)	Central Cluster (Balochistan)
Districts	Killa Saifullah, Zhob, Ziarat and Loralai.	Quetta, Mastung, Pishin, Killa Abdullah and Kalat.
Focal point district/Tehsil/ Mouza	Killa Saifullah	Quetta
Focal point area (ha)	24,950	1,471
Focal point production (tonnes)	261,975	13,312
Area of the cluster (ha)	34,790	16,859
Production of the cluster (tonnes)	332,144	155,007
Average yield (tonnes/ha)	8.48	9.19
Percentage of the crop area that lies in the cluster (apple area of the cluster/apple area in the country)	40.39%	17.39%
Percentage of the total cropped area in the cluster (apple area in the cluster/total cropped area in the cluster)	28.59%	26.43%
Geographical and Environmental Factors	• Silt loam, Sandy clay loam and silty clay loam, calcareous soil and gravely in nature.	• Silt loam, clay loam, sandy clay loam and sandy loam.
	• Plains and mountainous valleys	• Mountainous and flat lands
	• Climate is mild to very warm in summer and very cold in winter. Some areas come under monsoon range and some are arid.	• Climate is arid. These areas receive mostly winter rains with warm summers.
	• Mostly apples orchards are irrigated by tubewell water. Water is fit for irrigation.	• Tubewells are used for irrigation, and traditional Karez system is also in practice in some areas. Declining water table has increased the irrigation cost.
	• Average rainfall 50-300 mm. Most of the rain occur in winter and only Zhob area receives monsoon rainfall.	• Average rainfall 50–170 mm per year.

	• Temperature rises up to 35-40 °C during summer but drops to -15°C during winter. • Dry hot and cool nights are typical in summer.	• Temperatures frequently rise above 38°C between Mid-May and Mid-August but drops upto -5°C particularly during nights. • Dry hot days and cool nights are typical during the summer.
	• Dust storms do occur during early spring and late summer.	• Strong winds and dust storms may occur from mid-June to Mid-August.
	• Mostly dry during the fruiting season of June-August	• Dry and hot weather during May through July
Apple Farmers	• Low education profile of farmer thus difficult to introduce new technologies. • Large farm (>20 ha) have 41% of the orchard area in the cluster and their average orchard size is 3 ha. • Medium farms (>5 and <20 ha) have 26% of the total orchard area and their average orchard size is 0.4 ha • Small farmers (<5 ha) owns the remaining 33% of orchard area, and their average orchard size is 0.2 ha	• Low education profile of farmer thus difficult to introduce new technologies. • Large farm (>20 ha) have 41% of the orchard area in the cluster and their average orchard size is 3 ha. • Medium farms (>5 and <20 ha) have 26% of the total orchard area and their average orchard size is 0.4 ha • Small farmers (<5 ha) owns the remaining 33% of orchard area.and their average orchard size is 0.2 ha
Product Features	• Apples quality remain almost intact for 8 to 10 months in cold storage. • For optimum taste, it has to be consumed within few days after harvest. • Mostly red delicious variety is grown which is red to dark red colored fruit and oblong in shape. This variety is juicy and has slightly crisp flesh. It has no flavor at all but liked for its refreshing eating characteristic and attractive red color. • This late variety Golden Delicious is yellowish-green skinned and sweet flavored. It is very crispy and juicy. It has the highest shelf life characteristic.	• Apples remain almost intact for 8 to 10 months in cold storage. • For optimum taste, it has to be consumed within few days after harvest. • Both Red and Golden Delicious varieties are grown as main varieties however, Katja and Gala apple varieties are also grown on considerable area. • Katja is an early variety; shape is round and pinkish-red colored skin with sweet to taste. • Gala apples are non-uniform in color, fine textured and sweet flavoured.

	• Katja is also grown for its early maturing for marketing.	
Variety Feature	• Around 50 apples varieties are available out of which five to six varieties have become main commercial varieties. • Names of some apples varieties cultivated in this cluster are Red Delicious (Kala kulu), Golden Delicious (Shin Kulu), Katja, Amri, Kashmiri, Mondeal Gala, Summer Red, and Top Spur. While, Red Delicious, Golden Delicious and Katja are the main cultivars.	• Around 50 apples varieties are available out of which five to six varieties have become main commercial varieties. • Names of some apples varieties cultivated in this cluster are Red Delicious (Kala kulu), Golden Delicious (Shin Kulu), Katja, Amri, Kashmiri, Mondeal Gala, Summer Red, and Top Spur. While, Red Delicious, Golden Delicious and Katja are the main cultivars..
Nursery and Planting	• Some apple farmers raise their own nursery plants (saplings). • Apple saplings are also available at private and government nurseries. • Mostly 18 to 24 months old saplings are sold while 2-year old saplings are sold at double price. Propagation in apples is done through stooling method. Conventional method is used for raising and maintaining nurseries therefore, mortality ratio is high. • During the early apples orchards plantation, minor fruit trees (called Katcha tree) are planted. • Average number of plants is 175-200 per ha. • Normally orchards are properly layout. • After well establishment of main orchard the minor fruit trees are uprooted.	• Some apple farmers raise their own nursery plants. • Apple saplings are also available from private nurseries and also from government nurseries. • Mostly 18 to 24 months old saplings are sold while 2-year old saplings are sold at double price. Propagation in apples is done through stooling method. Scientific methods of raising and maintaining nursery, such as controlled atmosphere, and proper inputs and plant protection measures are not applied, therefore mortality ratio is high. • During the early apples orchards plantation, minor fruit trees (called Katcha tree) are planted. • Average number of plants is 175-200 per ha. • Normally orchards are properly layout. • After well establishment of main orchard the minor fruit trees are uprooted.

Inputs/Management Practices	• Normally, 8 irrigations are applied at intervals of 10-12 days in one season. • Micronutrients are applied in apple orchards. • Weeding is done manually and no weedicide is used. • Fertilizers application is very limited and whatever is applied is not judiciously applied. • However, some farmers apply fertilizers with following rates: • Nitrophos @ 2kg, SOP 1 kg, Zinc Sulphate 400 gm, and Amonium Sulphate 500 gm per tree. These elements are applied in split dose. Iron chelate 150gm (after fruit set during May). Compost 30 kg/tree. • Semi-decomposed cow dung at the rate of 2-3 cart per tree is used as FYM, which is very harmful for trees. • Intercropping with other fruit plants and fodder, cereal crops (such as alfalfa, wheat etc.) and vegetables is a normal practice. • Major insects of apples are codling moth and spider mites. • Mostly pesticides Emamectin 1.9 ec or Emamectin 5 ec, Chloropyriphos & Acetamiprid. While, for Spider mites Bifenthrin + abmecten & Prapergit are used while, rarely used against diseases. • Two to three sprays are done while in severe attack even more sprays are done.	• Normally, 8 irrigations are applied at intervals of 10-12 days in one season. • Micronutrients are applied in apple orchards. • Weeding is done manually and no weedicide is used. • Fertilizers application is very limited and whatever is applied is not judiciously applied. • However, some farmers apply fertilizers with following rates: • Nitrophos at the rate of 2kg, SOP 1 kg, Zinc Sulphate 400 gm, and Amonium Sulphate 500 gm per tree. These nutrients are applied in split dose. Iron chelate 150gm (after fruit set during May). Compost 30 kg/tree. • Fresh cow dung is used as FYM, which is very harmful for trees. 2-3 wheel barrows per tree. • Intercropping with other fruit plants and fodder, cereal crops (such as alfalfa, wheat etc.) and vegetables is a normal practice. • Major insects of apples are codling moth and spider mites. • Mostly pesticides Emamectin 1.9 ec or Emamectin 5 ec, Chloropyriphos and Acetamiprid. While, for Spider mites Bifenthrin+abmecten and Prapergit are used while, rarely used against diseases. • Two to three sprays are done while in severe attack even more sprays are done.
Pruning/Harvesting and grading	• No proper grading is done and even no grader is available. • Winter pruning is done by cutting the dead branches, but	• No proper grading is done and even no grading machine facility is available. • Winter pruning is done by cutting the dead branches, but

	generally pruning is considered loss to tree vigor. • No concept of summer pruning. • No exact know how about proper stage of maturity of apple fruit for its harvesting. • Farmers do not use any scientific maturity index. • Apple fruit is harvested manually i.e., by hand-picking. • No mechanized harvesting. • Pre-harvest losses is 7-10% and post-harvest losses are 30-40%	generally pruning is considered a loss to tree vigor. • No concept of summer pruning. • No exact know how about proper stage of maturity of apple fruit for its harvesting. • Farmers do not use any standard maturity index. • Apple fruit is harvested manually i.e., by hand-picking. • No mechanized harvesting. • Pre-harvest losses is 7-10% and post-harvest losses are 30-40%
Packaging/Transportation	• The harvested fruits are packed in wooden crates, or corrugated carton in several layers or even in mushed in sacs placed on roadsides. • Wooden crate weighs 18 kg and corrugated carton box also weighs same. The price of a wooden box is Rs.250-300 while, one paper box costs Rs.80 to 200. • Apples are transported in vans, lorries for short distances and trucks for long distances.	• The harvested fruits are packed in wooden crates, or corrugated carton in several layers or even in mushed in sacs placed on roadsides. • Wooden crates weigh 18 kg and corrugated carton box also weighs same. The price of a wooden box is Rs.250-300 while, one paper box costs Rs.80 to 200. • Apples are transported in vans, lorries for short distances and trucks for long distances.
Wholesale and retailing	• After harvesting fruit is graded and packed at a shady place in the orchard and transported in small vans, pickups and through trucks by big farmers • Contractors or wholesalers sometime buy the product from farmers. Large farmers directly bring their produce in the market for auctioning. • Mostly apple is sold as fresh in local and national markets. • No value addition, preservation, drying, and prominent industrial processing is done with surplus apples.	• After harvesting fruit is graded and packed at a shady place in the orchard and transported in small vans, pickups and through trucks by big farmers • Contractors or wholesalers sometime buy the product from farmers. Large farmers directly bring their produce in the market for auctioning. • Mostly apple is sold as fresh in local and national markets. • No value addition, preservation, drying, and prominent industrial processing is done with surplus apples.

	• The average price of apple is 80-140/kg. • The price is offered to the farmer based on the size, variety and quality of fruit as visually judged by the wholesalers/contractors. • The auction in the wholesale market is generally based on the variety and weight, but grading standards are not followed. • The commission agents and wholesale merchants do keep accounts of their transactions. • It is also strange that sale or auction of farmers' produce is done not in front of farmers. • As per market demand re-grading is done by retailers and exporters. • Lower quality and small size fruit is sold on road sides. • The prices remain high in the beginning of the season and after that then become unstable until the end of the season. • No warehouse or cold storage facility is available in the cluster. • Apples are mostly marketed in Karachi, Hyderabad, Lahore, Islamabad, Multan, and Faisalabad markets.	• The average price of apple is 80-140/kg. • The price is offered to the farmer based on the size, variety and quality of fruit as visually judged by the wholesalers/contractors. • The auction in the wholesale market is generally based on the variety and weight, but grading standards are not followed. • The commission agents and wholesale merchants do keep accounts of their transactions. • It is also strange that sale or auction of farmers' produce is done not in front of farmers. • As per market demand re-grading is done retailers and exporters. • Lower quality and small size fruit is sold on road sides. • The prices remain high in the beginning of the season and after that then become unstable until the end of the season. • No warehouse or cold storage facility is available in the cluster. • Apples are mostly marketed in Karachi, Hyderabad, Lahore, and other Sindh markets.
Certification	• Organic food certification is costly and not affordable to majority of the farmers.	• Organic food certification is costly and not affordable to majority of the farmers.
New Technologies/ Infrastructure	• The experience of high-density apple orchards has been gained.	• The experience of high-density apple orchards has been gained.
	▪ The use of corrugated boxes has recently been started for packing. ▪ The material for new high yielding varieties of apple is	▪ The use of corrugated boxes has recently been started for packing. ▪ The material for new high yielding varieties of apple is

	available. Besides their imports, initial screening has been done, and new high yielding apple varieties can be developed locally.	available. Besides their imports, initial screening has been done, and new high yielding apple varieties can be developed locally.
	• The optimum levels of fertilizer used for apple has been determined.	• The optimum levels of fertilizer used for apple has been determined.
	• The SOPs for keeping apples fresh for 30-35 days in cold chambers for export purposes have been developed by University of Agriculture Faisalabad.	• The SOPs for keeping apples fresh for 30-35 days in cold chambers for export purposes have been developed by University of Agriculture Faisalabad.
Supply Chain	• Less involvement of women in apple industry. • No consistency in variety and quality apples supply to high return markets. • Lack of cold chain (no cold storage, refer containers, proper cold storage in markets. • Organic food certification is costly and not affordable for majority of the farmers. • Majority of farmers and traders do not follow the commodity handling precautions and protocols. • Due to variations in quality so, no sustainability in prices. Uneven and uncertain prices spread throughout the year. • Uneven price spread throughout the chain.	• Less involvement of womenfolk in apple industry. • No consistency in variety and quality apples supply to high return markets. • Lack of cold chain (no cold storage, refer containers, proper cold storage in markets. • Organic food certification is costly and not affordable for majority of the farmers. • Majority of farmers and traders do not follow the commodity handling precautions and protocols. • Due to variations in quality so, no sustainability in prices. Uneven and uncertain prices spread throughout the year. • Uneven price spread throughout the chain.
Export/ domestic marketing	• SPS, Food safety standards and traceability standards such as HACCP, Europe GAP, Global Gap, IFS are not followed which cause major obstacle to enter into high-end markets. • Majority of farmers and traders do not follow the commodity handling protocols, which limit export.	• SPS, Food safety standards and traceability standards such as HACCP, Europe GAP, Global Gap, IFS are not followed which cause major obstacle to enter into high-end markets. • Majority of farmers and traders do not follow the commodity handling precautions and protocols, which limit export.

	• Lack of cold chain (no cold storage, refer containers, proper cold storage at markets) limit export and cause high post-harvest losses. • Complex procedures for shipment of apples limit its exports. • Although most of the apples are destined to markets of other provinces but still export potentials in the commodity exist but very fewer quantity is exported.	• Lack of cold chain (no cold storage, refer containers, proper cold storage at markets) limit export and cause high post-harvest losses. • Complex procedures for shipment of apples limit its exports. • Although most of the apples are destined to markets of other provinces but still export potentials in the commodity exist but very fewer quantity is exported.
Socioeconomic networking/ Gender involvement	○ Several projects on different aspects of horticulture has been implemented including apple crop particularly "Deciduous Fruit Development Center". ○ Balochistan Agriculture Department, Agriculture Research, Extension, BARDC, FAO and other Non Govt. Organizations are working on horticulture production including apple crop through different projects and interventions. ○ Stakeholders mobilization for greater awareness about the importance of farmers 'cooperation in understanding the value chain issues like certification, quality assurance, etc. through farmers' associations/ groups.	○ Several projects on different aspects of horticulture has been implemented including for apple crop particularly by the "Deciduous Fruit Development Center". ○ Balochistan Agriculture Department, Agriculture Research, Extension, BARDC, FAO and other Non-Governmental Organizations (NGOs) are working on horticulture production inclusive of apple crop through different projects and interventions. ○ Stakeholders mobilization for greater awareness about the importance of farmers 'cooperation in understanding the value chain issues like certification, quality assurance, etc. through farmers' associations/ groups.

Annexure-5: SWOT Analysis of Central and Northern Clusters in Balochistan.

Parameters	Strengths	Weakness	Opportunities	Threat
Environment/ Climate Change	Low temperate and dry climate makes the cluster ideal for cultivation of different cultivars.	In uplands of this cluster, late spring frost and cold waves may affect flowering and bearing of the fruit.	All early, mid and late apple varieties are harvested. simultaneously in both clusters. Dry climate favor clean cultivation of apples.	Less precipitation cause less production and small sized fruit at harvest with less water content and leathery skin.
	Less chances of occurrence of diseases with severity.	Apple trees are planted too close. With bushy type trees, it reduces aeration in the orchard. This creates micro-climate environment that can adversely affect the apples crop productivity.	High-density rootstocks with new and commercial varieties can be introduced in the cluster which are resilient to adverse climate change and require quite less water than the local germplasm.	Strong winds with dust storms occur frequently particularly during mid spring and in the months of August and September. This causes further dryness and severe infestation of mites.
Input Supplies	As plantation area is expanding, demand for input supplies including fertilizers and pesticides is increasing.	Non-availability of quality fertilizers and micronutrients at local input market is one of the weaknesses.	Conducive environment for private sector can fill the gap by providing input supplies to the growers of the cluster.	Lack of awareness regarding use of inputs, slow the uptake of inputs by the farmers. Inferior quality and adulterated inputs cause great set back to apples production.
	Demands for high and super high density and exotic varieties is increasing.	New germplasm is expensive and this can hinder expansion.	Well rotten/prepared compost can improve the soil condition and water holding capacity.	
		Limited availability of certified, quality, and true to type saplings.	Government can establish mother nurseries to provide different rootstocks and varieties.	
Cluster interaction	Agriculture is main sector of the cluster and apple is one of the major crops of most of the areas of this cluster.	Little interaction among farmers, extension agents and researchers and no platform for interaction.	Small and new farmers have chance to learn from progressive farmers in the cluster.	There is lack of coordination and integration among apple value chain actors.

	Existing apple value chain is fully functional in the cluster, producing high value apple crop for the growers, traders and retailers.	The apple growers have little information about the quality requirements in national and international markets.	There is possibility of collective efforts for achieving the economies of scale.	
		Little or no credit availability from formal institutes like Zarai Taraqiati Bank for the small growers in the area.		
Production Management practices	Thousands of farmers having traditional expertise in apples production, which can be used for production and quality enhancement.	Traditional orchard management practices are faulty. Presently most of the management practices are not helping in productivity and quality enhancement.	There exist great potential for both vertical integration of apple production.	Present drought span, existing poor irrigation system and out dated rootstocks and cultivars.
	Possibility of diversification into improved varieties.	Without any plantation system or unorganized and mixed plantation in orchards.		
	Existing yield per unit area can possibly be increased many folds.	Lack of soil health improvement or less than optimal dose of fertilizers.	There are opportunities for private sector to provide extension services. Agriculture Service Providers can also be an opportunity.	
		Pre- and post-harvest losses are due to lack of skills and infrastructure (i.e., storage facilities); losses/wastages are nearly 40% of total production.		
Transportation	The cluster has the strength of supplying the produce to any part of the country. In future CPEC is also a good opportunity for exports.	The conditions of existing access roads to main highways are not good.	For quality intact and infestation free fruit packaging paper boxes (corrugated) have already been introduced in apples and also being used in other fruits.	Floods during monsoon season cause blockage of roads, which hamper produce supply and destroy the produce as well.
		No cold chain system exists. No temperature, humidity maintenance and proper transportation system exist.		

		High transportation costs and fluctuation in transportation fares.	Quality apples are produced and presentation can be improved for orientation in regards to exports.	
		The cluster is apple producing center but without any cold chain and cold storage.		
Marketing	Improvement in marketing and trading environment can fetch good prices for quality apples of the cluster.	Apple growers sell their produce at throw away prices due to unawareness of high value market. No MIS.	Contract system has the potential to manage quality produce flow in the market with the help of commission agent's financial support.	Small farmers have reservations against high value markets. No loaning facility to small farmers and absence of SMEs discourage small apple growers.
		No grading system exists and fruit are packed with A grade at top while very small size fruit at the bottom.		
		Non-transparent auctioning of apple produce and absence of on spot grading causes losses to growers.	Sale of apples in big lots can be beneficial for growers.	
		Absence of capacity building of farmers and traders hinder improvement in produce quality, presentation and exports.	The emerging super markets trend in Pakistan and abroad are one of good opportunities for apple industry in Pakistan . And will narrow the trading gap.	
Trade/Export	Most of the produce is traded within the country and very small quantity is exported.	Quality apples have no food safety standards and traceability (HACCP, EuroGAP, Global Gap, IFS etc.) which are major obstacles to enter into high end international markets	Growing urban population of the country is one of good opportunities for locally produced apples	High cost of quality standards maintenance and its continuity is beyond affordability of the apple growers and high costs of certifications.
		Lack of transportation, airport, and port facilities, no cargo flights, shortage of air	Prospects for better prices for higher quality apple in	

		cargo space and inadequate cargo handling limit the exports.	domestic and international markets.	
Processing	Mostly apples are consumed fresh while, many by products can be made even industrial potentials also exist.	Apples can be stored for longer period but storage facility is not available therefore, processing industry is one of the options, which is not in position.		
		Unavailability of advanced processing units, technologies, and equipment for preservation and processing.	There is tax holiday on import of agriculture machinery including the cold storage equipment and processing machinery.	
	Apples have the potential for use in many bakery items and confectionary. Apple chips is one of the examples.	Small stakeholders have no capacity and financial support to process the produce.		

Annexure-6: Feasibility of apple juice making cluster

Items	Value									
# of machines in a processing units	50									
Capacity of producing juice/ machine (Kg of apple)	100									
Plant capacity per day (tonnes)	5									
working day in a year (days)	120									
Annual capacity (tonnes)	600									
		Year-0	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8
Revenues ($)										
Quantity of apple that goes in processing (tonnes)			600	600	600	600	600	600	600	600
Conversion ratio (1.4 tonnes of apple to one tonne of juice)			0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
Apple juice produced (tonnes)			429	429	429	429	429	429	429	429
Price of the juice (US$/tonne)			1200	1200	1200	1200	1200	1200	1200	1200
Revenue from juice (US$)			514,286	514,286	514,286	514,286	514,286	514,286	514,286	514,286
Dry matter produced @ 300 kg/tonne	0.29		171	171	171	171	171	171	171	171
Value of dry matter (US$/tonne) (@ Rs.5/kg)	37.04		6,349	6,349	6,349	6,349	6,349	6,349	6,349	6,349
Total revenues (US$)			**520,635**	**520,635**	**520,635**	**520,635**	**520,635**	**520,635**	**520,635**	**520,635**
Direct variable Costs (US$)										
Raw material price (US$/TONNE) plus transportation			549	549	549	549	549	549	549	549
Raw material cost			329400	329400	329400	329400	329400	329400	329400	329400
Packing costs (@PKR5 per 250g box or 1000/250*5=Rs.20 per liter)			63492	63492	63492	63492	63492	63492	63492	63492
Labor cost			58540	58540	58540	58540	58540	58540	58540	58540
Electricity and water			3052	3052	3052	3052	3052	3052	3052	3052
Chemical cost (@Rs.2000/tonne of juice)			6349	6349	6349	6349	6349	6349	6349	6349
Maintenance (1% of the machinery, equipment and furniture cost)			482	482	482	482	482	482	482	482
Land and building lease charges (10%) increment on annual			4800	5040	5292	5557	5834	6126	6432	6754
Marketing (US$10/tonne)			6000	6000	6000	6000	6000	6000	6000	6000
Depreciation cost			1963	1963	1963	1963	1963	1963	1963	1963
Total Variable Costs (US$)			**474078**	**474318**	**474570**	**474835**	**475113**	**475405**	**475711**	**476033**
Gross profit			**46556**	**46316**	**46064**	**45800**	**45522**	**45230**	**44924**	**44602**
Indirect fixed cost										
Machinery		-48194								
Licensing and regulatory fee		-150	0	0	0	0	0	0	0	0
Total		-48344	0	0	0	0	0	0	0	0
Grand total cost		**-48344**	**474078**	**474318**	**474570**	**474835**	**475113**	**475405**	**475711**	**476033**
Net profit (Net Cash Flow)		**-48344**	**46556**	**46316**	**46064**	**45800**	**45522**	**45230**	**44924**	**44602**
NPV	**8.50%**		**193,199**							
IRR			**95%**							

Annexure-7: Feasibility of pack house for apple clusters[4]

Apple is deciduous popular fruit crop. This tree crop is widely grown in temperate and colder regions of the world. The apple is one of the most popular and healthy fruits. The apple fruit stood 3rd in terms of production worldwide (Statista, 2018). Apple is not only consumed as fresh, it is also used for making different products like juices, jam, jellies, marmalade, cider, etc. It is a rich source of calcium, phosphorus, iron, sodium, and potassium (Westwood, 1978). Apples contain considerable amount of polyphenols and relevant phytochemicals. The apple fruit have limited shelf life due to its perishable nature. The entire value chain process flow is semi-automatic requiring both skilled and unskilled workers.

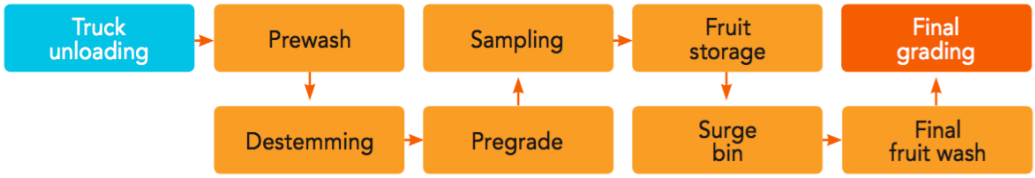
Pack house unit proposed here will treat and pack the mentioned products on internationally acceptable standards making the final product compatible enough for local market and even export. The unit would add value to the fruit by bringing it to the international standards, giving it greater shelf-life and lowering the overall wastages.

Objective:

The objective of this feasibility study is to estimate feasibility of the packhouse in apple for the future investors so that following functions in the value chain can be incorporated:

- Cleaning, Insect pest and diseases control after harvest, grading, packing, cooling, loading etc.

The diagrammatic process flow is described below;



Step One

Grading Lack of product uniformity within a container is a serious constraint to marketing fresh fruit, particularly for export. It is very important to have as much uniformity in size, shape, and color within the package as possible. Many countries have national grade standards for each individual commodity that growers must adhere to in marketing their products. Such grade standards do not exist in Pakistan, and therefore a wide variation in fruit quality is common in the domestic market.

Step Two

[4] Information for this section was gathered from various sources including:
1. SMEDA, 2017. Pre-Feasibility Study – Apple Grading, Waxing and Packing Unit (For Gilgit Baltistan).

A dull surface appearance diminishes the attractiveness of apples. Food-grade waxes are widely used internationally on apples to enhance their appearance and slow shriveling. For those markets in which appearance is critical, apple growers should have available the capability to wax their fruit. The mechanics of waxing generally consists of applying a liquid form of wax to the dry surface of the fruit following washing. The procedure is generally automated and part of the packinghouse operation.

Step Three

The packing materials used by the majority of Pakistani fruit growers are not conducive to protecting the product quality and are inferior in appearance and design for the export market. Unfinished 18-kg wooden crates are widely used for domestic marketing of apples. The outer appearance of the crate is not attractive and does not enhance the value of the product inside. Furthermore, the rough inner surface of the standard wooden crate can result in significant physical injury to the delicate skin of the commodity if it comes in direct contact with the rough wood surface.

Product arrival and Pre cleaning/sorting

The amount of heat in produce is governed by the temperature around it. The temperature difference between newly harvested produce and its optimum storage temperature is an indicator of field-heat. Rapidly lowering the temperature of harvested produce to near storage temperature is known as pre-cooling, or removal of field-heat. Produce is usually pre-cooled to 78 or 88 percent of the temperature difference. Additional cooling is limited by the time and energy required to reduce the produce temperature to the optimum storage temperature.

Pre-cooling equipment and procedures need to be incorporated into the packing shed design. Packed produce should pass quickly and efficiently from the packing line to the pre-cooling area. Removal of field heat from the produce is important to prolong and maintain its post-harvest life.

Many methods are available to pre-cool fruits and vegetables. It is essential to rapidly cool produce to optimum storage temperature. Studies have shown that pre-cooling greatly increases produce storage life. Without pre-cooling, many common fruits and vegetables would not be available in quantity and quality. Cold storage slows produce respiration and breakdown by enzymes, slows water loss and wilting, slows or stops growth of decay-producing microorganisms, slows the production of ethylene, the natural ripening agent, and “buys time” for proper marketing. Metabolic activity of fruits and vegetables produces heat. Produce also stores and absorbs heat. The objective of optimum storage conditions is to limit the production, storage and absorption of heat by produce.

Following are the most common pre-cooling methods used internationally:

- Room Cooling
- Hydro-cooling
- Evaporative Cooling

If hydro cooling is used, special attention must be made to how the cooling water is managed. If the water source can supply both the packing line and the hydro-cooling, then where and how the waste water will be disposed needs to be addressed and dealt with.

If air-cooling is used, extra cold storage units and high-capacity refrigeration units will be needed. Cold storage is the last stop before the produce is shipped to market. For small growers who markets what they pack daily, this may be just a cool corner by the door before it is loaded for market.

Refrigerated cold storage is recommended if the produce is not marketed every day. It should be close to the shipping area.

Main grading washing and packing hall:

The main grading washing and packaging hall is the place where most of the operation will be conducted. A proposed layout of the facility is attached as under;

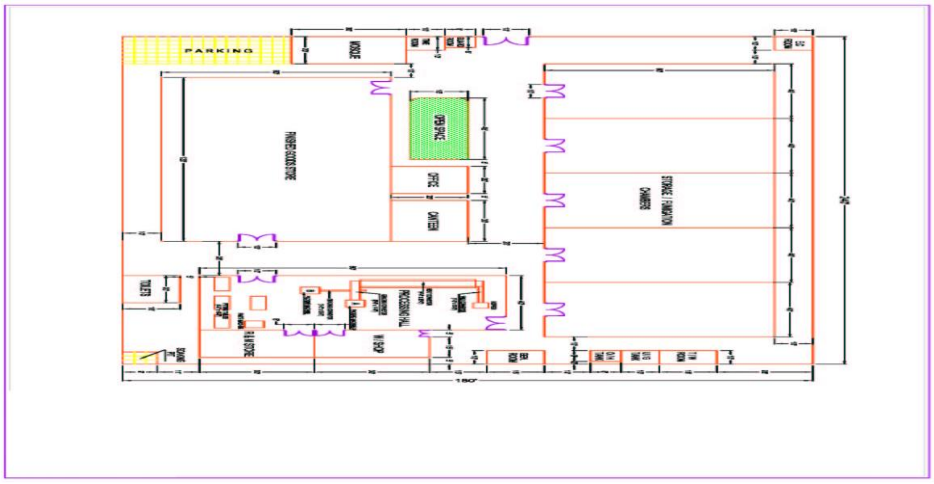


Figure A7-1: Map of the Apple pack house

Machinery and Equipment:

Selection of plant and machinery is the most important decision for setting up a food processing unit. All machinery and equipment used in the processing line should have proper efficiency. All the plant and machinery should be erected in such a way that the material flow is unidirectional to avoid cross contaminations. The machinery should not occupy more than 1/3rd of the total floor area for smooth operation of labour.

1. Chain Pulley Block
    - Capacity: 5 Tonnes
    - Supplier: Max Industries, India
    - Supplier Product Code: HH2050
    - Price: US $1200
    - Power Source: Hand Pulled

2. Motorized Conveyor for Bulk Material Handling
    - Supplier: AMC System Technology (Suzhou) Co., Ltd
    - Model No. – AMCRL006
    - Dimension (L*W*H) – Customized
    - Voltage – 110V/220V/380V
    - Power – 1500 W or Customized
    - Capacity – 1500kg or customized
    - Price – US $1300
3. Hydraulic Pallet lift (manual)
    - Supplier: Baoding Dali Hoisting Machinery Co. Ltd
    - Model No. – PDL -3T hand Pallet
    - Price – US $250
4. Box Strapping Machine
    - Supplier: Henan Bedo Machinery Equipment Co. Ltd
    - Model No. – BD-001
    - Voltage – 220V
    - Power – 50 KW
    - Price – US $250
5. Electronic Weighing Machine
    - Supplier: Yuvo
    - Model No. – 730
    - Voltage – 220V
    - Capacity – 1500kg
    - Price – US $900
6. Shrink Wrapping Machine
    - Supplier: Ruian Yongxin Machinery Factory
    - Model No. – BTH 450 + BM500L
    - Dimension (L*W*H) – 3850*1500*1300mm
    - Voltage – 220V/380V
    - Power – 50Hz
    - Price – US $3000
7. Grading and Sorting Table
    - Supplier: Tianjin Sure International Trading Co. Ltd
    - Model No. – Sure -CBM
    - Dimension – 1000 - 10000mm
    - Voltage – Customized
    - Power – 0.18 – 2.5KW
    - Price – US $ 3000

8. Platform Type Scales
    - Supplier: Sanghai Uni-weigh System (Tech)Co. Ltd
    - Price – US $ 1700
9. Tray Wrapping Machine
    - Supplier: Shandong China Coal Group Ltd
    - Model No. – HW450
    - Dimension – 540*680*200mm
    - Voltage – 220V
    - Power – 270W
    - Price – US $ 1800
10. Hot Air Dryer
    - Supplier: Henan Xingyang Mining Machinery Manufactory
    - Model No. – ZT
    - Dimension – Depends on the model
    - Voltage – 380V
    - Price – US $ 8,000
11. Washer
    - Supplier: Zhengzhou Azeous Machinery Co. Ltd
    - Model No. – AUSNW
    - Dimension (L*W*H) – 3800*760*1200mm
    - Voltage – 380v/50hz/3phase
    - Power – 3.5KW
    - Capacity – 500kg – 4000kg/hr
    - Price – US $ 7000
12. Small cold store
    - Supplier: Taizhou Nimbus Machinery Co. Ltd
    - Price – US $3400

13 Grading and sorting table
- Automatic vegetable grading and sorting line (1 tonne per hour)
- Price-US$1000-27000
- Supplier: RUIAN

13. Supper silent DEUTZ
    - Solar generator (60KVA)
    - Price-US$8900
    - Supplier –Fujian XINHENGXIN Motor Company Limited

Pack house project summary

Plant capacity	10 Tonnes per day; 1200 tonnes annually
No. of shifts	One (8 hours per shift) per day

Working days in a year	120

Capital Costs:

Land and building:

For building and civil work about 6,000 sq. feet of land will be required for this project and built up area required will be 1500 sq. ft. consisting of production hall, washing, packaging, storage etc. The cost of building and civil work would be US$**16000** at a rate of US$10/square feet assuming land will be leased in the project.

Plant and Machinery:

The cost of plant & machinery is estimated at US$ **86000** including installation and commissioning. The installed production capacity will be 10 tonnes per day. The cost estimates for plant & machinery has been worked out based on the cost figures available from recent orders paced for similar items in the recent past, duly updated to cover the price escalation.

Plant and Machinery

S. No.	Particulars	Qty.	Rate (US$)
1.	Solar generator	1	8900
2.	Chain Pulley Block	1	1200
3.	Motorized conveyor for bulk material handling	1	1300
4.	Hydraulic pallet lift manual	1	250
5.	Box strapping machine	1	250
6.	Electronic weighing machines (1500Kg.)	1	900
7.	Shrink Wrapping Machine	1	6000
8.	Grading & Sorting Table	1	3000
9.	Inspection Tables	3	300
10.	Platform Type Scales (30kg)	2	1700
11.	Platform Type Scales with Printer (15 kg)	10	150
12.	Platform type scales (120 kg)	5	100
13.	UPS for above Machines	5	200
14.	Tray Wrapping Machine	1	1800
15.	Hot Air Dryer – for Removing water applied Externally	1	8000
16.	Waxing Unit	1	2500
17.	Washer	1	7000

18.	Automatic vegetable grading and sorting line (1 tonne per hour)	1	15000
19.	Packaging machine, Pouch sealing machine	1	170
20.	Cold Storage	1	7000
21.	PU Building for Pack house (1500 sq. ft.)	1	16000
22.	Ethylene Generator 3 nos. (Sure Ripe)	1	200
23.	Ethy-gen II Concentrate (45 cases)	1	200
24.	Gastech. Air Sampling Kit Unit 1 no. 1	1	180
25.	Ethylene Monitoring Tube - 1 Box	1	180
26.	Carbon di-oxide Monitoring Unit	1	400
27.	1 0.04 0.04 30 Additional Dryers for Removing Moisture- 1MT Per Day	1	120
28.	Pallets and Bins		3000
	Total		**86000**

Misc. Fixed Asset Costs:

US$ **21580** has been estimated under the heading of miscellaneous fixed assets. The details of electrical installations for power distribution have been considered commensurate with the power load and process control requirements. Other miscellaneous fixed assets including furniture, office machinery & equipment, equipment for water supply, office stationery, telephone and refreshment, workshop, fire-fighting equipment, etc. will be provided on a lump sum basis as per information available with the consultants for similar assets. The details of miscellaneous fixed assets and their associated costs are been shown in table below:

Miscellaneous fixed asset cost

S. No.	Particulars	Qty.	Rate (US$)
1.	Office Equipment	1	2000
2.	Furniture and Fixture	1	3000
3.	Miscellaneous Accessories	1	2000
4.	Vegetable Display Crate	50	200
5.	Display Board	5	60
6.	Fire Fighting	1	70
7.	Computer with Accessories	2	1000
8.	ERP System	1	10000
9.	Water Treatment Plant – 500 litres per hour	1	1000
10.	Loading Tempo	1	250
11.	Electrical and water pipes Installation	1	2000
	Total		**21580**

Pre-Operative Expenses:

Expenses incurred prior to commencement of commercial production are covered under this head that total US$ **52600.** Pre-operative expenses include establishment cost, rent, taxes, traveling

expenses and other miscellaneous expenses. It has been assumed that the funds from various sources shall be available, as required. Based on the project implementation schedule, the expected completion dates of various activities and the estimated phasing of cash requirements, interest during construction has been computed. Other expenses, under this head have been estimated on a block basis, based on information available for similar projects.

Pre-Operative Expenses

Sr. No.	Particular (for 1 year)	Amount (US$)
1.	Interest up to production @ 16% on term loan amount of US$ 138000 **(30% of total project cost)**	22000
2.	Electricity charges during construction period	4000
3.	Marketing Launch Expenses	5000
4.	Technology Know-how and consultancy fees	10000
5.	Training expenses	5000
6.	Travelling Expenses	6000
	Total	**52600**

Cost of raw material:

Based on a processing capacity of 10 tonnes per day taking into account and 90 days of working per year, the annual raw material consumption of the pack house is 900 tonnes. The cost of fresh apple based on its average selling price as determined through interview with randomly selected farmers and converting it into US$ (with conversion rate of one US$=135) is $529/tonne.

Adding US$20 per tonne transportation cost from the field to pack house, the raw material cost for pack house would be US$529.

Cost of raw material

Particulars	Rate per tonne (US$) for the raw apple at the wholesale/pack house	Qty. (Tonnes) per season	Raw material cost (US$)
Apple	529	1200	634800

Land Lease Charge:

Required land is 6,000 sq. ft. which has been considered on lease @ US$200 per annum for first three years and @ US$200 for the fourth year and subsequently @ 5% increase every year.

Land lease charges

S. No.	Year	Lease charges Per annum (US$)
1.	1st year	200
2.	2nd year	200
3.	3rd year	210
4.	4th year	220
5.	5th year	231
	Total	**1061**

Electricity and Water Consumption Charges:

The unit cost of electricity has been considered @ PKR.20.70/ unit assuming that the entire power requirement is met from the grid. A power supply of 60 KVA is deemed appropriate. The expense on water supply, treatment and distribution has been suitably considered, based on the tariff by water and sanitation agency (WASA) for per month consumption of water tariff of @ 92.82 PKR/thousand gallon. Water requirements are approximately 500 gallons per day.

Electricity and water consumption charges

S. No.	Description	Amount Per Annum (US$)
1.	Power Consumption	4000
2.	Water Consumption	200
	Total	**4200**

Human Resource Cost

One pack house manager, one accountant for six months, one supervisor for six months technical staff Salaries & wages (including benefits) for different categories of employees have been considered based on present day expenses being incurred by other industries in the vicinity. The breakdown of manpower and incidence of salaries & wages are detailed in the table Salary & Wages. Salary & wages are increased @ 5% every year

Salary and wages

Sr. No.	Description	Requirement	Salary/month (US$)	Salary/annum (US$)
1.	Pack house manager	1	750	9000
2.	Accountant	1	520	6240
3.	Supervisor	2	740	8880

4.	Skilled Workers	4	1200	4800
5.	Driver	1	370	4440
6.	Security Guard	2	450	5400
	Total		**3805**	**38760**

Cost of Project

Sr. No.	Particular	Value (US$)
	Fixed costs	
1.	Plant and Machinery	86000
2.	Misc. Fixed Assets	21580
3.	Pre-operative expenses	52600
	Operating costs	
1.	Cost of raw material	634800
2.	Land lease charges	1061
3.	Electricity and water consumption	4200
4.	Salary and wages (For 120 days)	38760
5.	Margin Money for Working Capital	1500
6.	Contingencies 5% of Fixed Assets	2158
	Total variable costs	**842659**

Project Income Statement

Items	Value									
Plant capacity per day (tonnes)	10									
working day in a year (days)	120									
Annual capacity (tonnes)	1200									
		Year-0	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8
Revenues ($)										
Quantity of apple that goes in value addition (tonnes)			1200	1200	1200	1200	1200	1200	1200	1200
Price of the value added apple (US$/tonne)			877	877	877	877	877	877	877	877
Total revenues (US$)			1,052,400	1,052,400	1,052,400	1,052,400	1,052,400	1,052,400	1,052,400	1,052,400
Direct variable Costs (US$)										
Raw material price (US$/tonne) plus transportation			549	549	549	549	549	549	549	549
Raw material cost	0.29		658800	658800	658800	658800	658800	658800	658800	658800
Packing costs (@Rs.25/6 kg box)	37.04		37037	37037	37037	37037	37037	37037	37037	37037
Labor cost			38760	38760	38760	38760	38760	38760	38760	38760
Electricity and water			4200	4200	4200	4200	4200	4200	4200	4200
Maintenance (1% of the machinery, equipment and furniture cost)			3203.6	3203.6	3203.6	3203.6	3203.6	3203.6	3203.6	3203.6
Land and building lease charges (10%) increment on annual			6000	6600	7260	7986	8785	9663	10629	11692
Marketing (US$10/tonne)			12000	12000	12000	12000	12000	12000	12000	12000
Depreciation cost			10205	10205	10205	10205	10205	10205	10205	10205
Total variable Costs (US$)			**770206**	**770806**	**771466**	**772192**	**772990**	**773869**	**774835**	**775898**
Gross profit			**282194**	**281594**	**280934**	**280208**	**279410**	**278531**	**277565**	**276502**
Indirect fixed cost										
Machinery		-160180								
Licensing and regulatory fee		-150	0	0	0	0	0	0	0	0
Total		-160330	0	0	0	0	0	0	0	0
Grand total cost		**-160330**	**770206**	**770806**	**771466**	**772192**	**772990**	**773869**	**774835**	**775898**
Net profit (Net Cash Flow)		**-160330**	**282194**	**281594**	**280934**	**280208**	**279410**	**278531**	**277565**	**276502**
NPV	**8.50%**		**1,307,291**							
IRR			**176%**							

NPV = 1,307,291
IRR = 176%

Project Viability:

The Internal Rate of Return of the project is estimated at **176**%, which is significantly higher than the bank return rate of 16%. Hence, the project is deemed financially viable. The NPV of the project is positive (US$1,307,291) at a discount factor of 16% during the first 5 years of operation considered. This implies that the project generates sufficient funds to cover all its cost, including loan repayments and interest payments during the period. This also indicates that the project is financially viable over the long term.